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Energy Research Abstracts

Abstracts 39781-41409

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UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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The citations presented in *ERA* are available for on-line searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

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Managing Editor, Audrey B. Smith
Technical Editor, M. Catherine Grissom

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

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6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
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18. **Conference title, location, and date,** if applicable.
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20. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).

Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

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Corporate Author Index

The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 14:18255 (R;US)

Personal Author Index

Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 14:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)

Subject Index

This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

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TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 14:18686 (RA;SU;In Russian)

Contract Number Index

DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
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FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**
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Report Number Index

Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

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Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the data base records.* The following list includes all of the 40 first-level and the 289 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope.*

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Energy Research Abstracts

01 COAL AND COAL PRODUCTS

0103 Preparation

Refer also to citation(s) 39837, 39838, 39839, 39865, 39877

39781 (CRIE–W-87038) **Study on CWM dry preparation systems at water-air mixed jet pump.** Ono, Tetsuo; Koyata, Kazuo. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jul 1988. 30p. (In Japanese). Order Number DE89760383/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

CWM(coal water mixture) dry preparation using water-air mixed jet pump was studied. Dry method, wet method and combined dry-wet method are used to prepare CWM. Wet method which makes easily CWM, is much used because dry method is easy to grind but difficult to make CWM. But wet method has higher equipment cost, power cost and manufacturing cost owing to lower crushing efficiency. It is necessary to make dry manufacturing of CWM possible which is now problem, to reduce the CWM manufacturing cost. For this reason, the new dry method to prepare CWM using the water-air mixed jet pump which is utilized in the civil dredging work, was developed by absorbing the pulverized coal into CWM instantaneously and sufficiently, thus offering a great possibility. 10 references, 18 figures, 10 tables.

39782 (DOE/PC/63049–T2) **Ultrasonically enhanced size reduction of coal, Phase 2: Final report.** Energy and Minerals Research Co., Exton, PA (USA). Nov 1988. 41p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-83PC63049. Order Number DE89015146/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During this period of time, Energy and Minerals Research Company (EMR) worked to develop pilot plant-sized ultrasonic grinding equipment. Ultrasonic grinding has been shown, in some cases, to be an efficient method for comminuting coal. In addition, ultrasonic grinding is potentially more energy efficient and capable of liberating more pyrite than other grinding methods, for example ball or hammer million. Prior work by EMR on ultrasonic grinding show that the new technique might be used to more efficiently grind coal to relatively small particle sizes. EMR showed that the primary ultrasonic fracture event results in daughter particles that are approximately one-third the size of the mother particle. Fines production was apparently minimized by ultrasonic grinding. 12 figs., 8 tabs.

39783 (DOE/PC/88877–T1) **Coal surface control for advanced physical fine coal cleaning technologies: Quarterly report, February 1, 1989–April 30, 1989.** Morsi, B.I.; Chiang, S.H.; Sharkey, A.; Blachere, J.; Klinzing, G.; Streeter, R.; Gray, R.; Venkatadri, R.; Cheng, Y.S.; Chiarelli, P. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. 1989. 115p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88877. Order Number DE89014127/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The analytical techniques for characterization of the surface/bulk properties of coal and associated mineral matter including pyrite (Task 3) have been completed. The standard agglomeration test (Task 4) have been developed. The grinding studies (Task 5), and the modification of particle surfaces (Task 6) have been initiated during this quarter. Accomplishments to date are summarized in this report. 3 refs., 36 figs., 44 tabs.

39784 (DOE/PC/88883–T3) **Development of the electroacoustic dewatering (EAD) process for fine/ultrafine coal: Third quarterly progress report, [April–June 1989].** Battelle Memorial Inst., Columbus, OH (USA). 18 Jul 1989. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88883. Order Number DE89015883/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Battelle, in cooperation with the Electric Power Research Institute (EPRI), Ashbrook-Simon-Hartley (ASH), Kaiser Engineers (KE), Lewis Corporation, and Professor S.H. Chiang of the University of Pittsburgh, is developing an advanced process for the dewatering of fine and ultrafine coals. The advanced process, called Electroacoustic Dewatering (EAD), capitalizes on the adaptation of synergistic effects of electric and acoustic fields to commercial coal dewatering systems, such as belt filter presses. 2 figs., 2 tabs.

39785 (ETDE-mf–9794801) **Briefing package II: Development and testing of optimum comminution techniques and equipment for producing suitable feed coals for new technologies. Final report.** Leonhard, J.; Gwosdz, A. Bergbau-Forschung G.m.b.H. - Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.). Abt. Aufbereitung; Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.). [1988]. 237p. (In German). Order Number DE89794801/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; NTIS (US Sales Only), PC A07/MF A01.

The quality criteria defined for feed coals for new technologies can only be met by special comminution machinery and techniques. A number of systems were tested in the course of this investigation. The experiments covered: Impact stress in a hammer mill; pressure in a roller mill; combined pressure and shearing stress. The systems investigated were a rolling mill, a centrifugal rolling mill, a vibration grinding mill, and an intermittent ball mill. The collective experiments were supplemented by studies on the effects of impact, pressure and shearing stress on single grains. Five different coals were used for the experiments. (orig./HS).

39786 (EUR–11846, pp. 19-27) **Improved processing of hard-to-purify coal slimes.** Brunello, J.M. (CERCHAR, Rueil Malmaison (France)); Daniel, J.L.; Nomine, M. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European community Information Service, 2100 M St., NW, Washington, DC 20037.

The objective of the present project is to study new beneficiation routes for coal slimes prior to their formulation into CWF. The efficiency of concentration processes was measured. This permits the classification in decreasing order of efficiency: coarse slurry gravity separation; true heavy liquid cycloning; teetering bed elutriation; spiral; water washing cyclone - fine slurry beneficiation; selective agglomeration; flotation. The study of CWF preparation from the whole range of beneficiated slurries permits us to evidence the best coal quality from the point of view of its slurriability. 3 figs.

39787 (EUR–11846, pp. 28-32) **Generating plant for coal-water-air mixtures (C-WAM).** Sevelinge, G. (Framatome Creusot Energie, Le Creusot (France)); Antonini, G.; Mattei, J.L. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service, 2100 M st., NW, Suite 707, Washington, DC 20037.

To increase the coal content of coal-water mixtures up to 75% by weight, FRAMATOME and the Universite de Technologie de Compiegne/D.G.T.E. have developed a process to produce continuously coal-water air mixtures (C-WAM). Laboratory tests have been performed to choose a convenient foaming agent and to determine the state equation of a compressive C-WAM. A pilot unit generating pressurized C-WAM and feeding a 150 KW burner in a continuous way has been designed. This unit will be regulated by a PB 400 programmable automate to reach a 2% accuracy for the burner feeding flow. 4 figs.

39788 (EUR–11846, pp. 33-42) **Preparation of purified coal-water fuels.** Klose, R.B. (Salzgitter Industriebau GmbH (Germany, F.R.)); Mueller, T. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European

boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The aim of this R & D project is the development of an environmentally acceptable and economic process for the preparation of low-pollution coal-water fuels (DENSE-COAL), which can also be used as a substitute for diesel and other fuels and which are typified by the fact that the grain size of the coal is less than 10 μm, the solids content in the slurry greater than 60% wt. and the ash and sulphur content less than 1% wt. Preliminary investigations and research revealed that a pneumatic flotation is best suited for the purification process. The alternatives examined were mainly sedimentation process, agitated flotation and column flotation. These separation processes will be kept in mind for a future optimized multi-stage plant. Once the decision was taken regarding the process to be used, the design, ordering of the plant components and the installation of a pilot plant began. Using the pneumatic flotation it could be demonstrated already during the commissioning stage that this process produces better results in the fine-grained range (100% less than 200 μm) than agitated flotation. A Polish coal with a maximum grain size of 200 μm was purified from an approx. 10% wt. ash content to only 1.9 % wt. 2 refs., 1 fig., 5 tabs.

39789 (EUR–11846, pp. 43-46) **Process for the production of low-pollution coal-water fuels.** Schwartz, E. (BASF AG, Ludwigshafen (Germany, F.R.)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Chemical and physical analyses of coal from Polcargo (Poland), Cerrejon (Colombia), and Smoky River (Canada) were performed to collect data on possible intergrown characteristics of coal particles and by-products. To get information on whether a leaching technique known under the name 'AMAX Process' may or may not be an alternative to the mechanical coal cleaning process assigned for this project, a test series corresponding to AMAX was run. The results were not very positive. 1 ref., 5 tabs.

39790 (STEV-TORV–89-5) **Efficient mechanical dewatering by adding microfungi.** Nordstroem, M. Statens Energiverk, Stockholm (Sweden). 1988. 29p. (In Swedish). Order Number DE89902421/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

To achieve an effective dewatering of peat slurries one can induce aggregation of the negatively charged peat particles which restrict the waterflow through the peat matrix and the filter during pressing. When polyelectrolytes are added aggregation of the particles takes place. Microorganisms can produce polyelectrolytes, polysaccarides and proteins, which all can induce aggregation of particles in soil. Microfungi, Mortierella isabellina and Penicillium spinulosum, were added directly to slurries of Carex peat. Two different methods were then used to dewater the peat: pressing and filtration. The results achieved with the two methods were in close agreement. Adding M. isabellina mycelia to a slurry of slightly decomposed Carex peat before pressing decreased the water content to 3.2 (kg water/kg dry peat) compared with the untreated control with a water content of 6.0 after pressing. Similar results were obtained with filtration. M. isabellina did not improve dewatering of highly decomposed Carex peat. P. spinulosum did not improve dewatering of slurry of either slightly or highly decomposed Carex peat. This work thus demonstrated the possibility of using microfungi as dewatering agents. It was also shown that the moss Sphagnum majus can be used as a growth medium for the fungi.

39791 Oil agglomeration of coal in salt solutions: effects of hydrophobicity and other parameters on coal recovery. Fan, C.W. (Iowa State Univ., Ames (USA)); Markuszewski, R.; Wheelock, T.D. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 756-764 (1988). DOE Contract W-7405-ENG-82. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

The recovery of fine coal or graphite particles suspended in water by agglomeration with heptane was observed to be highly dependent on the relative hydrophobicity of the solids as indicated by the measured induction time, i.e., the time required for attachment of one or more particles to a small gas bubble when brought into contact. For highly hydrophobic coal or graphite particles, an increase in ionic strength of the suspending medium caused an increase in agglomeration recovery and a decrease in measured induction time. For weakly hydrophobic coal or pyrite particles, an increase in ionic strength caused a decrease in agglomeration recovery and an increase in induction time. Due to the opposing effects of ionic strength on the recovery of a highly hydrophobic coal and pyrite, it was possible to improve the separation of these materials by an increase in ionic strength. On the other hand, because the recovery of pyrite and a weakly hydrophobic coal were affected similarly by ionic strength, it was not possible to improve the separation of these materials by a similar increase.

39792 Improved sulfur removal from coals by redox potential control of surfaces during grinding. Tampy, G.K. (Iowa State Univ., Ames (USA)); Birlingmair, D.H.; Burkhart, L.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 818-825 (1988). DOE Contract W-7405-ENG-82. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Control of the redox potential of an Upper Freeport run-of-mine coal slurry during wet grinding and subsequent beneficiation gave better sulfur removal, with no decrease in coal recovery, than either potential control during grinding or beneficiation alone. Sodium dithionite, a reducing agent used to depress the sulfur, also gave substantially better results than pH control alone, irrespective of whether the physical beneficiation was by oil agglomeration, foam flotation, or microbubble batch flotation. Three-phase contact angle measurements and pulp potential measurements suggest that slow electrochemical reactions at the particle surfaces may be responsible for the improved results obtained when the reductant is added at the grinding stage.

39793 Coal comminution by high pressure water jets, machine design conceptual study. Galecki, G. (Univ. of Missouri, Rolla (USA)); Mazurkiewicz, M.; Wijeratne, L. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 832-841 (1988). DOE Contract AC22-86PC91271. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

In the offered paper the authors present the results of the work conducted on the coal response for high pressure water jets attack. The paper covers different types of water jets such as: solid jets, cavitating jets, and rotating jets and also the results of coal disintegration effectiveness. The concepts of the models of comminuting machines are presented. The mechanism of the coal disintegration in relationship to these models and the process efficiency are discussed.

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Refer also to citation(s) 39824, 39832, 39833, 39835, 39842, 40093, 40126, 40138

39794 (ACERR–1982, pp. 20) **Evaluation of pyrolysis of a subbituminous coal.** Chakrabartty, S.K. (Alberta Research Council, Edmonton, AB, Canada); du Plessis, M.P. Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). 1982. (CONF-8210362–: 32. Canadian chemical engineering conference, Vancouver (Canada), 3-6 Oct 1982; CE–02652). In *Alberta Research Council [research reports-1982].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

This paper evaluates pyrolysis as a means of partial liquefaction of thermal coals normally used for electric power generation. Little is known about fast flash pyrolysis where the objective is to optimize production of liquids and gases. Factors determining the pyrolysis behaviour are: scission of bonds resulting in structural fragments, in-situ interaction of the fragments, solid and fluid interface chemistry, and volatility of the thermally stable products. The coal's behaviour depends not only on the properties of the coal (for example, rank, mineral content, maceral composition, swelling and caking propensities, etc.) but also on the conditions under which

pyrolysis occurs. Assays from three laboratory methods were compared with results from continuous flow pyrolysis and hydropyrolysis reactors. The Fourier transform infrared vacuum pyrolysis technique was fund to give a measure of effective volatile content of this coal as determined by the classical ASTM method. Results of this study include conventional ASTM analysis, Gray-King and Fischer-Schrader Assays, FTIR-vacuum pyrolysis and tests in continuous-flow pyrolysis and hydropyrolysis reactors. The optimum volatile contents of the coals and its measurement and relation to the yield of liquid and gaseous products from flash-pyrolysis and hydropyrolysis reactors are discussed. 4 refs., 9 tabs.

39795 (ACERR–1982, pp. 24) **Modeling of liquefaction reactors.** Ozum, B. (Alberta Research Council, Edmonton, AB, Canada); Gibb, W.J.; du Plessis, M.P. Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). 1982. (CONF-8210362–: 32. Canadian chemical engineering conference, Vancouver (Canada), 3-6 Oct 1982; CE–02652). In *Alberta Research Council [research reports-1982].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

This paper describes preliminary work undertaken to assist in developing design criteria and mathematical models for coal liquefaction reactors. Coal liquefaction is a process in which coal is treated with a hydrogen donor solvent in the presence of hydrogen gas with or without the addition of catalysts at elevated temperatures and pressures to convert the coal into a liquid or semi-solid fuel of low ash and sulphur content. The products obtained are affected by the characteristics of the coal (rank, petrographic composition and geological history) and donor solvent and by the type of process being used. Stirred tank and tubular reactor models were considered for the coal liquefaction process. If reaction data at various temperatures and pressures can be obtained as a function of the chemical constituents, that data can be incorporated into a more elaborate optimization scheme. this information (from mini autoclave, hot charge, or more preferably from bench unit) can also be used for the design and optimal operation of liquefaction reactors. 22 refs., 3 figs.

39796 (ACERR–1982, pp. 12) **Reactivity of char from subbituminous coals.** Parkash, S. (Alberta Research Council, Edmonton, AB, Canada); du Plessis, M.P. Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). 1982. (CONF-8210362–: 32. Canadian chemical engineering conference, Vancouver (Canada), 3-6 Oct 1982; CE–02652). In *Alberta Research Council [research reports-1982].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

Heat treatment conditions affect the degree of graphitization of carbonaceous materials and this in turn influences the reactivity of the char/coke. An experimental investigation of the reactivity of char produced from various pyrolysis processes on Alberta subbituminous coals was undertaken to develop a simple reactivity test for systematic use on a range of subbituminous coal chars produced under various process conditions and to obtain some measure of the variables which affect the reactivity. Char is the primary product of coal pyrolysis. Char from reference coals, representative of the full range of geographic, rank and geological variations present in the Alberta Plains coal region, and from hydropyrolysis, was analyzed. The analysis comprised petrographic analysis, including random reflectance, surface area, pore volume and porosity by N_2 and He adsorption. Conclusions are that thermogravimetric analyses, petrography and surface property measurements are useful techniques for comparative evaluation of chars produced from different coals and under different process conditions; application of these techniques to chars produced from three reference coals shows significant differences in reactivity among chars produced under similar pyrolysis conditions; and chars produced by hydropyrolysis of Highvale coal at different temperatures and pressures show significant differences, particularly in surface area and in CO_2-reactivity which are higher at the process condition combining the higher temperature (800^{0}C) with the lower pressure (5.5 megapascals.) 7 refs., 4 tabs.

39797 (ARC-CR-YCLQ–19) **Effect of added H_2 or CS_2 on the liquefaction of Alberta subbituminous coals in I.G. Farben and CO steam process.** du Plessis, M.P. Alberta Research Council, Edmonton, AB (Canada). Coal Research Dept. 1983. 42p. Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A OG1.

This report describes results of batch autoclave liquefaction tests carried out with Alberta subbituminous coal, anthracene oil and catalysts. The objectives of this program were to examine the influence of H_2 on coal conversion and liquid products yield in two liquefaction process types: H_2 in presence of Fe_2CO_3 (I.G. Farben) and CO/steam in presence of K_2CO_3; to evaluate the catalytic effect of H_2SCS_2 in liquefaction reactions without heterogeneous catalysts; and determine the difference, if any, in liquefaction yields when sulfur is introduced either as H_2S or CS_2. The experiments confirmed that, under process conditions investigated the efficiency of both liquefaction processes was increased significantly (I.G. Farben > CO/steam) in terms of coal conversion and liquid yield as well as in liquid product selectivity. Better results were obtained with H_2S than with CS_2. The major advantages of using H_2S are: increased coal conversion into liquid yields; improved activity of heterogeneous catalysts (presulfiding); improved selectivity in liquids generation; and high product recovery. Also, H_2S performs as an effective, inexpensive catalyst itself, and is of particular interest because of its ready availability in Alberta as a by-product from sour gas and heavy oil processing plants. 5 refs., 7 figs., 22 tabs.

39798 (CONF-890509–2) **Analysis and molecular cloning of genes involved in thiophene and furan oxidation by Escherichia coli.** Alam, K.Y.; Worland, M.J.; Clark, D.P. Southern Illinois Univ., Carbondale, IL (USA). Dept. of Microbiology. 1989. 21p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79912. From 11. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (USA); 8-12 May 1989. Order Number DE89015156/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Alternative methods for the desulfurization of coal are currently needed. The microbial removal of organic sulfur from coal is addressed in this issue by attempting to construct by genetic means, strains of bacteria which can degrade thiophenes and related organic sulfur compounds. Our first attempts in this direction have resulted in the isolation of a series of mutant strains of Escherchia coli with successively increased oxidizing ability towards furan and thiophene compounds. Three novel genes involved in thiophene oxidation, thdA, thdC, and thdD, were identified and mapped on the E. coli chromosome. In addition, mutations in two previously known regulatory genes fadR and atoC were also required. Further work resulted in more accurate mapping of thdA and thdD relative to known chromosomal genes and the isolation of a further mutation, thdE, so far unmapped. This conference presentation reviews some more recent findings, including the cloning of several genes involved in thiophene metabolism. 23 refs., 2 figs., 5 tabs.

39799 (DOE/PC/60782–T3) **Toward new coal hydroprocessing and liquefaction catalysts: Final technical report, August 16, 1983–August 15, 1986.** Stanford Univ., CA (USA). Dept. of Chemical Engineering. 1986. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-83PC60782. Order Number DE89011426/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Research on the hydrodesulfurization catalyst Co-Mo-S/Al_2O_3 is described. The most useful result of this work is the first demonstration of the possibility of carrying out in situ studies of HDS catalysts in a special new cell with beryllium windows. This cell permits a study of the catalytic materials during HDS at pressures up to 14 MPa and temperatures up to 700 K in a synchrotron radiation facility to obtain structural and chemical data. 7 refs.

39800 (DOE/PC/88854–T1) **Application of selected microorganisms for organic sulfur removal from coal: Quarterly progress report, December 15, 1988–March 15, 1989.** Boyden, B.H. Louisiana Tech Univ., Ruston, LA (USA). 13 Dec 1989. 22p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88854. Order Number DE89015878/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Progress is reported on coal desulfurization by microorganisms. This quarter, ten pounds of Illinois No. 6 coal were ground, homogenized and stored under nitrogen. Arrangements are being made to

procure quantities of Kentucky No. 11 and Pittsburgh No. 8 coals. Treatment of the Illinois No. 6 coal for pyrite and sulfate removal is proceeding. Some delay was encountered due to inactive (i.e., old, lysed, few viable cells) cultures of Thiobacillus ferrooxidans and Thiobacillus thiooxidans, but new cultures were obtained. Also, screening of 45 pathway isolates and 45 bacteria continued. 1 tab. (CBS)

39801 (ECN–89-081) **Coking properties of coal and burnout effects.** Vleeskens, J.M.; Hamburg, G.; Roos, C.M. Netherlands Energy Research Foundation, Petten (Netherlands). May 1989. 9p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Paper presented at the 2. international symposium on coal science, Rolduc, Netherlands, 21-25 May 1989.

Char formation in the first step of combustion can be regarded as the birth of a sponge which is open to the air. Its reactivity, however, can be impaired if the walls formed are thick. It also can be impaired if the walls undergo restructuring as a result of coking reactions. In fluidised combustion where char particles collide with harder particles, coking has been shown to affect fuel performance. Also in pulverised fuel combustion coked particles have been reported to be dominant in the combustion residues. The authors have been working on ways to visualize coking behaviour in combustion and pyrolysis products by scanning electron microscopy and to interpret fluidised combustion data in the light of the relative hardness of combustor coke. 7 figs., 6 refs.

39802 (ECN–89-101) **Identification of coal pyrolysis products by scanning electron microscopy.** Vleeskens, J.M.; Kwiecinska, B.K.; Hamburg, G.; Roos, C.M. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1989. 10p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Scanning electron microscopy (SEM) is a useful method for studying coal pyrolysis products. Using SEM, coked macerals were recognized by flow patterns formed during the plastic stage. Reduced coking properties could be observed on oxidized coals. Particular attention was given to coal conversion products obtained under the heating conditions of fluidized bed combustion, because coke formation has an adverse effect on the process. SEM-results were in general agreement with optical data. 4 figs., 7 refs.

39803 (EPRI-GS–6439) **Long-term leaching tests with coal gasification slag: Final report.** Thompson, C.M.; Achord, R.D.; Browman, M.G. Electric Power Research Inst., Palo Alto, CA (USA); Radian Corp., Austin, TX (USA); Tennessee Valley Authority, Muscle Shoals, AL (USA). c Jul 1989. 237p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The primary objective of this study was to characterize leachate quality for representative coal gasification solid residues in an environment that represented one of the disposal practices that TVA uses. An additional objective was to compare the leachate quality for solid residues produced by gasification of different types of coal. The approach taken was to investigate the chemical characteristics of waters in contact with coal gasification slags disposed in small surface impoundments (field test cells). Slags from gasification of two coals were placed in lined field test cells. One feed coal was a low sulfur (0.4%) western bituminous coal produced by Southern Utah Fuel Company (SUFCO). The other feed was Illinois No. 6 coal, a medium sulfur (2.8%), midwestern bituminous coal. 9 refs., 17 figs., 19 tabs.

39804 (EUR–11845, pp. 57-72) **Closed loop controlled integrated hot gas cleanup.** Andries, J. (Laboratory for Thermal Power Engineering, Delft (Netherlands)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

The availability of hot gas clean up systems which can meet environmental regulations and protect other system components is essential for the introduction of advanced coal conversion processes. Granular bed filtration is considered as a promising technique. This report describes the progress in the project during the first 2 years. During the operation of the sub pilot-scale pressurised fluidised combustor a number of experimental problems were experienced. The coal feed system, the construction of the bottom part of the first cyclone and the operating procedure were modified. The influence of operating parameters on the elutriation of solids from the combustor and the operation of the two high temperature cyclones has been determined. Laboratory-scale test rigs which are used for the development of on-line, in-situ particulate measurement systems, recycle cyclones and electrostatic enhancement of granular bed filtration have been designed and built. Measuring instruments for the determination of electrostatic-, flow- and sintering properties of ash and filter materials at high temperatures and the in-situ charge of particulates in the exhaust of a PFB combustor are under development and some preliminary results have been obtained. 7 refs., 6 figs., 4 tabs.

39805 (EUR–11845, pp. 81-88) **Development of a dust separator for hot gas clean-up.** Taillet, J. (ECOPOL, Paris (France)); Rennhack, R. Societe ECOPOL, 75 - Paris (France). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

A new method for injecting electric currents in a gas stream in order to charge fine dust particulates has been proposed and patented by ONERA (French Aerospace Research Institute). Laboratory studies by ECOPOL, performed since 1982, have shown that the charge collected by the fines is appreciable, and that the current can be injected in high pressure and/or high temperature gas streams. The contract mentioned above has the following objectives: apply the method in the laboratory to several types of dust separator (a granular bed filter, and electrostatic precipitator, a scrubber and a fabric filter) in order to determine the advantages of this new process; select an industrial facility at one of the plants installed by LURGI and proceed to the necessary modifications to adapt this new type of charging device; and perform a full scale experiment, and compare the results (filtering efficiency, clogging, pressure drop and energy requirements) to the previous performances of the facility. 7 refs., 5 figs.

39806 (Juel-Spez–490) **The solubility of synthesis gas components and mixtures thereof in water. Introduction in the thermodynamics of absorption and development of a correlation equation.** Kremer, M. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Jan 1989. 58p. (In German). Order Number DE89794893/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

The Institute of Reactor Components (IRB) at the Nuclear Research Centre Juelich is investigating within a project on energy alcohols, the industrial process engineering involved in the conversion of primary energy carriers (natural gas, coal and biomass) to energy alcohols. This process is subdivided into three parts: synthesis gas production, synthesis gas preparation and alcohol synthesis. One main point is the development of new processes of alcohol synthesis. From this point of view the investigation of a three-phase equilibrium of synthesis gas, liquid water and gas hydrates has to be considered with the object of gas preparation for alcohol synthesis. For the experimental and theoretical work on studying this three-phase equilibrium it is necessary to know the solubility of the synthesis gas components CO_2, CH_4, N_2, CO and H_2 in water. The development of a correlation equation and adjustment to the various systems of synthesis gas - water is the subject of this paper. In the first part the solubility of the pure components in water is considered. The second part deals with transfer to the multi-component system (synthesis gas - water). Because of a lack of experimental data for the whole system only test data from the partial systems were compared with the computer calculations. (orig.).

39807 (NEDOJ–8810) **FY 1987 NEDO annual report. Part 1.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Sep 1988. 332p. (In Japanese). Order Number DE89760508/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - Available from New Energy Development and Industrial Technology Organization, Tokyo, (Japan).

This book is Part I (total 2 parts) of the NEDO (New Energy Development Organization) Annual Report of 1987 and contains the following items. I. Coal energy development: A. Coal technology development – Liquefaction, gasification, jet-bed coal gasification, etc. B. Coal resources development – Basic study, overseas geological survey. II. Geothermal energy development: A. Geothermal technology development – Geothermal water power generation, high-temperature rock power generation. B. Geothermal resources development – National geothermal resources survey, geothermal development promotion study, demonstrative survey. In the area of coal liquefaction, design, construction and operation of a pilot plant (50 t/d) was carried out for a bituminous coal liquefaction and a brown coal gasification. For the coal gasification, development on the level of 1000 t/d coal treatment and 100 MW power generation was carried out. For a hydrogen manufacturing technology, the development level was 20 t/d. Total 332 pages. 116 figures, 54 tables.

39808 (UCRL–101165) **Mild coal gasification: Development of a screw pyrolyzer.** Camp, D.W.; Mallon, R.G. Lawrence Livermore National Lab., CA (USA). Jul 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-48. (CONF-890666–2: Gasification and gas stream cleanup systems, Morgantown, WV (USA), 27-30 Jun 1989). Order Number DE89016640/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our overall objective is to produce information needed for the development of an efficient continuous process for the mild gasification of caking bituminous coals. We are focusing on the development of an externally heated pyrolyzer in which the sticky, reacting coal is conveyed by one or more screws. Our process development experiments will yield recommendations for the design and operation of large scale screw pyrolyzers. 6 figs., 1 tab.

39809 Mild gasification of coal in a moving bed reactor. Sundaram, M.S. (Brookhaven National Lab., Upton, NY (USA)); Fallon, P.T.; Steinberg, M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 34(1): 1-8 (1989). (CONF-8904169–: Symposium on the fundamentals of gasification, Dallas, TX (USA), 9-14 Apr 1989).

The Brookhaven National Laboratory (BNL) tubular moving-bed reactor was used to perform gasification experiments with Wellmore Kentucky No. 8 bituminous coal under mild reaction conditions at two levels of the process variables: temperatures of 550° and 650°C, coal particles residence times of 0.1 min. and 2 min.; and lime addition of 0% and 10% of the coal fed, with inert N_2 as the sweep gas. Using a fractional factorial statistical design, the interactive effects of process variables were evaluated. The highest total hydrocarbon yield of 22.6% (MAF) was obtained at 650°C and 2 min. coal residence time in the presence of 10% lime additive. The gaseous hydrocarbon yield added only another 0.8% to the total hydrocarbon yield under the above conditions. The effect of coal residence time on total hydrocarbon yield was significant only at the higher temperature level of 650°C and in the presence of the lime additive. In general, increase in residence time, other conditions being equal, tends to decrease the retention of sulfur in char. The presence of lime in the feed had a beneficial effect on the retention of sulfur in the char only at low residence times.

39810 Effects of minerals and pyrolysis conditions on char gasification rates. Serio, M.A. (Advanced Fuel Research, Inc., Hartford, CT (USA)); Solomon, P.R.; Bassilakis, R.; Suuberg, E.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 34(1): 9-21 (1989). DOE Contract AC21-85MC22050;AC21-86MC23075. (CONF-8904169–: Symposium on the fundamentals of gasification, Dallas, TX (USA), 9-14 Apr 1989).

In previous work, a large set of coals was pyrolyzed under the same conditions, and it was observed that there was a systematic variation in char reactivity with coal rank as indicated by the oxygen content in the raw coal. The current paper extends that study to include the effects of minerals on reactivity differences from these coals. Most of the work concerns reactivity in oxygen, although selected data on reactivity in carbon dioxide are presented. The previous papers have also addressed the effects of pyrolysis conditions (temperature and heating rate) and char physical properties (surface area, resistivity, crystallite size) on char reactivity. The main conclusions were that for low rank coals the reactivity was primarily dependent on the extent of pyrolysis as measured by the char hydrogen (or oxygen) content and relatively independent of the time-temperature history. Based on limited data, it was also noted that the same conclusion with respect to heating rate could not be made for demineralized low rank coals or medium and high rank coals. The current paper revisits the subject of pyrolysis conditions with additional data and also reexamines the previous conclusion that differences in BET surface areas, as measured by CO_2 or N_2 adsorption, are not primarily responsible for large differences in reactivity between chars pyrolyzed under similar conditions.

39811 Nature of carbon-oxygen complexes produced by different oxidants: Towards a unified theory of gasification?. Hall, P.J. (Brown Univ., Providence, RI (USA)); Calo, J.M.; Teng, H.; Suuberg, E.M.; May, J.A.; Lilly, W.D. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 34(1): 112-120 (1989). DOE Contract AC21-87MC23284;FG22-87PC79929. (CONF-8904169–: Symposium on the fundamentals of gasification, Dallas, TX (USA), 9-14 Apr 1989).

Studies suggest a strong similarity between the chemical nature of such complexes, thereby potentially providing a unifying basis for the gasification of carbon by oxidizing species. In one such study, Marchon et al chemisorbed O_2, CO_2 and H_2O onto polycrystalline graphite at different temperatures, performed linear temperature programmed desorption (TPD) at a heating rate of 50 K/min, and compared the resulting desorption spectra. The principal TPD features were large CO desorption peaks at 973, 1093 and 1253K. They tentatively assigned these features to semi-quinone functional groups. It was concluded that the activation energy for adsorption was determined by the local surface environment of the group, the surface coverage, and the nature of the adsorbing molecule itself. The present paper has two principal objectives: to further test the theory of the universal nature of oxygen complexes by comparing the TPD spectra of a char oxidized in O_2, CO_2, NO, HNO_3 and H_2O_2; and the reactivity question, which is approached by analyzing TPD data, and reactivity and surface area measurements for a gasified char.

39812 Catalytic gasification of graphite and chars. Heinemann, H. (Lawrence Berkeley Lab., CA (USA)); Somorjai, G.A.; Pereira, P.; Carrazza, J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 34(1): 121-129 (1989). DOE Contract AC03-76SF00098. (CONF-8904169–: Symposium on the fundamentals of gasification, Dallas, TX (USA), 9-14 Apr 1989).

In earlier papers the authors reported on the low temperature catalytic gasification of carbonaceous materials with steam. The use of catalysts is necessary if the process is to be carried out at temperatures below 1000 K. While alkaline or alkaline-earth hydroxides and carbonates have been studied by many investigators, they show catalytic activity only at temperatures above 1000 K. Transition metals, in particular nickel and iron, are able to catalyze the process at temperatures as low as 750 K but they deactivate very fast. These transition metal catalysts are active only if the reaction conditions permit their presence in the metallic state. In the earlier work they described catalysts which are mixtures of potassium hydroxide and nickel oxide and have demonstrated that they showed the highest activity of all the systems previously studied at below 1000K. They also showed that this catalyst mixture formed a relatively low melting eutectic that can wet the surface of the carbon substrates forming a liquid film which attacks the carbonaceous material by edge recession mode rather than by a channeling mode which prevails for potassium hydroxide alone and nickel alone. A disadvantage found with the potassium-nickel catalysts is that they have a tendency to deactivate over a period of time when used on chars due to an interference or poisoning by ash components in the char. The present paper presents information on the role of ash components on catalytic gasification and describes another type of catalyst, namely a mixture of alkali and earth alkali oxides such as K_2O-CaO, which is almost as active and is less sensitive to poisoning than the potassium-nickel composition.

39813 Variations in the oxygen chemisorption capacity of mild gasification char at various levels of burnoff. Khan, M.R. (Morgantown Energy Technology Center, WV (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry*

(USA), 34(1): 192-201 (1989). (CONF-8904169–: Symposium on the fundamentals of gasification, Dallas, TX (USA), 9-14 Apr 1989).

The results of this study demonstrate that the conventionally defined unoccupied active surface area, as determined by oxygen chemisorption capacity at various levels of burnoff, does not seem to strictly correlate with the reactivity rate at various levels of burnoffs. This study suggests that stable sites may play a key role in reactivity, but their exact role at this stage of investigating is only speculative. The observed phenomenological changes in the measured OCC (active surface area not occupied by stable sites), as determined by oxygen chemisorption, at various levels of burnoff have been explained in terms of three competing mechanisms: (a) depletion of active sites available on the char surface caused by formation of a stable C-O complex, (b) increase of nascent active sites because of pore opening, and (c) decrease of OCC in the final stage of burnoff because of pore wall burnoff. The normalized reaction rate, based on a 10 to 70% burnoff time for different reaction temperatures, resulted in a single characteristic curve for a given type of char that was reacted at any reaction temperature. This finding suggests that the different reference times used widely in the literature do not necessarily signify parameters of fundamental importance.

39814 New discrete simulation method for modeling char gasification in the diffusion-controlled regime. Zygourakis, K. (Rice Univ., Houston, TX (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 34(1): 202-211 (1989). DOE Contract FG22-87PC79930. (CONF-8904169–: Symposium on the fundamentals of gasification, Dallas, TX (USA), 9-14 Apr 1989).

Cellular automata and discrete iterations are employed to develop a new simulation method for gas-solid reactions. This approach overcomes many of the limitations of earlier models since it can handle heterogeneous systems with multiple porous reactants and arbitrary pore/solid geometries. The new models are used to simulate the gasification of porous char particles under conditions leading to strong intraparticle diffusional limitations and to low utilization of the micropores. In order to accurately account for the effects of the macropore structure on char reactivity, the new models employ computational grids obtained by digitizing images of actual char particle cross-sections using an optical microscope equipped with a video camera and an image processing computer. Simulation results are presented from multiple runs performed on several char samples that were prepared in their laboratory by pyrolyzing two parent coals under various operating conditions. Model predictions are compared and analyzed in order to elucidate the effects of the macropore structure on the gasification rates and particle burn-out times.

39815 Biothermochemical conversion of a bituminous coal. Sundaram, M.S. (Brookhaven National Lab., Upton, NY (USA)); Sundaram, S.K.; Lin, M.; Premuzic, E.T. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 34(1): 244-248 (1989). DOE Contract AC02-76CH00016. (CONF-8904169–: Symposium on the fundamentals of gasification, Dallas, TX (USA), 9-14 Apr 1989).

Some exploratory experiments were conducted using Wellmore Kentucky No. 8 bituminous coal, (carbon 77.2%, hydrogen 4.9%, nitrogen 1.5%, sulfur 1.3%, oxygen 6.4% and ash 8.7%), and a microorganism, from the BNL collection, BNL-2-46 strain. The product was then pyrolyzed in an inert nitrogen atmosphere to 850°C at a heating rate of 100°C/min in a thermogravimetric apparatus. The microbial treatment with BNL-2-46 strain caused a positive enhancement in total yield of volatiles as shown. At the same time, another organism, BNL-3-25 strain, caused only a minor change in the volatiles yield. This experiment had demonstrated that the microorganisms play a role in enhancing the production of volatile materials from coal. Microbial treatment alone can produce a cleaner starting material with less sulfur content, less ash content, less mutagenicity, and above all, a product that is more amenable for further thermal degradation. By itself, gasification can produce smaller molecules from coal and a variety of desirable products, the slate of which can be easily altered by changing the processing conditions. The integration of the developing biotechnology of bacterial treatment using different microorganisms, different strains of the same microorganism and/or combination of all in conjunction with the already well developed gasification technology is an interesting and desirable concept which should be pursued further.

39816 Biodegradation of coal-related model compounds. Campbell, J.A. (Pacific Northwest Lab., Richland, WA (USA)); Stewart, D.L.; McCulloch, M.; Lucke, R.B.; Bean, R.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 514-521 (1988). DOE Contract AC06-76RL01830. (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

The details of the specific reactions of lignin biodegradation, and the biochemistry involved, have been primarily based on the use of low molecular weight compounds representing specific substructures rather than the complex, polymeric lignin material. The authors have studied the reactions of model compounds having coal-related functionalities (ester linkages, ether linkages, PAH) with the intact organisms, cell-free filtrate, and cell-free enzyme of C. versicolor to better understand the process of biosolubilization. Many of the degradation products have been identified by gas chromatography/mass spectrometry (GC/MS). Results are discussed.

39817 Biosolubilization of coal in aqueous and non-aqueous media. Faison, B.D. (Oak Ridge National Lab., TN (USA)); Scott, C.D.; Davison, B.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 540-547 (1988). (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Biocatalytic solubilization of coal can be achieved by microorganisms in aqueous medium or by enzymes in aqueous or organic media. In these systems, coal is converted to a liquid product through a variety of oxidative and/or hydrogenative reactions. The mechanism and control of coal solubilization activity have been studied in organisms associated with coal in nature. The solubilization apparently involves catalysis by alkaline cell metabolites. The aqueous product of this microbial action may be a suitable substrate for other biological interactions such as biogas production by methanogenic organisms. Enzymatic coal solubilization has been demonstrated in both shake flasks and fluidized-bed reactors. The process has been carried out under both anaerobic and aerobic conditions, with aqueous and hydrous organic solvents. The solubilization product of the anaerobic process is much less polar than that from microbial solubilization.

39818 Microbial conversion of coals to clean fuel forms. Barik, S. (ARCTECH, Inc., Alexandria, VA (USA)); Isbister, J.; Hawley, B.; Forgacs, T.; Reed, L.; Anspach, G.; Middaugh, T. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 548-553 (1988). DOE Contract AC21-87MC23285. (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Anaerobic cultures have been used for the production of methane and alcohols from coal. Cultures were adapted from natural inocula collected from sources such as sewage sludge and horse manure. A 1% (w/v) slurry of leonardite, lignite, or subbituminous coal was used in the incubations. Methane was produced from all cultures, including some untreated coals, to a greater extent than in control cultures. Over several months of adaptation, methane production capacity increased considerably. Volatile fatty acids (VFAs) were identified as intermediates in the conversion of coal to methane. A proposed scheme for the conversion is breakdown of the coal polymer by a series of organisms and metabolism of the fragments to methane precursors such as VFAs. A mixture of short chain alcohols was produced by cultures grown in the presence of methane inhibitors. These cultures after prolonged adaptation show potential for use in larger scale bioreactors for the production of gaseous and liquid fuels.

39819 Effects of multivalent cations found in coal on alkali- and biosolubilities. Quigley, D.R. (Idaho National Engineering Lab., Idaho Falls (USA)); Breckenridge, C.R.; Dugan, P.R.; Ward, B. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 580-586 (1988). DOE Contract AC07-76ID01570. (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Extraction of low-rank coals with dilute hydrochloric acid resulted in the removal of a small percentage of total ash present. Calcium,

and to a lesser extent, aluminum, magnesium and iron were present in acid extracts. Resulting coals were significantly more soluble in dilute alkali and more readily biosolubilized than water treated controls. These data suggest that some of the multivalent cations are present in coals as alkali insoluble complexes and contribute to the structural integrity of the coal.

39820 Microbial treatment of coals and its effect on ash fusion properties. Krishna, C.R. (Brookhaven National Lab., Upton, NY (USA)); Francis, A.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 587-589 (1988). (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

One objective of this study was to characterize the microbial demetalization and desulfurization of coal by the bacterium Thiobacillus ferrooxidans under aerobic conditions. The effects of type of coal, coal particle size, and nutrient concentration on the bacterial leaching of coal were investigated. Ash fusion temperatures of treated and untreated coal samples were measured and an attempt was made to relate variations to the coal and ash properties. Another objective was to determine the extent of dissolution of different metals from coal residues by the action of native autotrophic bacteria under aerobic conditions. The effects of inorganic nutrient supplements were also studied. It was concluded that microbial action on bituminous coals under aerobic conditions can lead to significant reductions in inorganic sulfur, metals and total ash content, as well as considerable increase of ash fusion temperatures of the remaining ash.

39821 Solubilization of leonardite by white-rot fungi grown in stationary and shake flasks. Dahlberg, M.D. (Pittsburgh Energy Technology Center, PA (USA)); Bockrath, B.C.; Speers, V.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 631-638 (1988). DOE Contract AC05-76OR00033. (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Oxidized coals, including a naturally oxidized lignite identified as leonardite, are solubilized and sometimes degraded further by a variety of fungi and bacteria. Evidence for biosolubilization of coal was first presented by Fakoussa, and Cohen and Gabriele. Subsequent studies concentrated on screening organisms, characterization of the product, and determination of the biochemical mechanisms. Mechanisms of biosolubilization are poorly known and may vary with the species used and the media. There is evidence for both enzymatic degradation and alkaline solubilization. The objective of this study was to discover critical factors in solubilization and biosolubilization mechanisms by testing a variety of growth media, growth conditions, and fungi. Lignin-degrading species were emphasized because of similarities between the structures in lignin and in low-rank coals. The results indicate that during idiophase (secondary metabolism), the fungi produce alkaline materials that solubilize leonardite.

39822 Extraction rates and porosity changes of coals in supercritical THF. Olson, E.S. (Univ. of North Dakota, Grand Forks (USA)); Diehl, J.W.; Horne, D.K.; Bale, H.D. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 826-831 (1988). DOE Contract FG22-86PC90521. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Important facets of the thermal processing of coals in a dissolving medium, such as that which occurs in liquefaction or extraction, are the rate of dissolution and the concomitant change in the surface structure of the coal. The interaction between these two related parameters is being studied by extracting coals in a flow-through cell under supercritical conditions and measuring the rates of extraction by on-line ultraviolet spectroscopy and the changes in pore structure of the coal by in situ small-angle X-ray scattering. The advantages of utilizing supercritical fluids in this project are the solvent densities, which are similar to liquids, the high solubility parameters, and yet low viscosities, similar to gases. For these experiments the solvent should be composed of first row elements and not have significant absorption in the uv. In addition, alcohols cannot be used since they destroy the aluminum windows of the extraction cell. Several solvents were tested in these investigations, and supercritical tetrahydrofuran (THF) was the only one found satisfactory for both measurements. The supercritical THF gave good yields of extract from even lignites, and the extracted material remained soluble in liquid THF.

0105 By-products

39823 (EUR–11845, pp. 161-168) **The utilisation of PFA (pulverised fuel ash) as a filler in rigid polyurethane insulation foams.** Sheehan, P. (Polycomp Ltd., Dublin (Ireland)); O'Sullivan, P.; Hamm, T. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW, Suite 707, Washington, DC 20037.

The use of pulverised fuel ash (PFA) as a filler for low density polyurethane insulation foams has been evaluated. The chemical and physical interaction of PFA and polyurethane was investigated. The mixing characteristics of PFA/polyurethane were examined. PFA/polyurethane foams were tested to see if their properties were within the minimum properties specified in BS5608 (1986). Mixing was seen as the key factor in attaining a good quality foam with high loading levels of PFA. Methods of improving the mixing of PFA and polyurethane were examined. A longer mixing time was obtained by removing the catalyst from the polyurethane chemical system and adding it to the PFA/polyurethane mix at the end of the mixing period. This enabled a 30% PFA loading in polyurethane chemicals to be obtained with the properties of the resultant foam within those specified in BS5608 (1986). The study was extended to examine the effect which silane coupling agents have upon the properties of a polyurethane foam filled with 30% PFA. It was seen that silane coupling agents decreased the insulation properties of the foam. Fire tests were completed on PFA filled polyurethane foams. PFA improves the fire properties of a polyurethane foam by forming a char on the surface of the foam. Research and development work continues with PFA/polyurethane in a high density particle board. 8 refs., 9 tabs.

0106 Properties

Refer also to citation(s) 39783, 39791, 39802, 39822, 39823, 39857, 39866

39824 (ARC-CY-YCLQ–23) **Simulated microdistillation of coal-derived liquids by thermogravity.** Iacchelli, A.; Selucky, M. Alberta Research Council, Edmonton, AB (Canada). Coal Research Dept. 1983. 19p. Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A OG1.

Boiling point distribution range is one of the parameters to define the properties of a liquid mixture. To use this parameter in process quality control, a suitable rapid method of analytical or simulated distillation of micro-quantity sample is needed. Thermogravimetry (TGA) is capable of separating liquid samples by boiling point, and, with proper experimentation, can be used to simulate distillation. The physics of distillation is based on the equilibrium condition between the gaseous and the liquid phase, which is hard to achieve in TGA. This report explores various experimental conditions to satisfy this demand on phase equilibria. The study, which is exploratory in nature and based on three samples of known boiling point distribution, provides some understanding of the influence of variable heating rate, purge gas flow rate, sample size and sample vessel design, and forms the basis of further development work. 2 refs., 5 figs., 6 tabs.

39825 (CONF-8906104–1) **Mass spectrometric studies of coals and coal macerals.** Winans, R.E. Argonne National Lab., IL (USA). 1989. 42p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From First symposium on advances in coal spectroscopy; Salt Lake City, UT (USA); 14-16 Jun 1989. Order Number DE89015129/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper will explore the characterization of coal-derived materials by High Resolution Mass Spectroscopy (HRMS). Coals are very complex and heterogeneous on both a microscopic and molecular level. The microscopic heterogeneity can be reduced by working

with macerals separated from the whole coal. Macerals are the microscopically identifiable plant remains which make up the organic portion of coals. The molecular make up of the various macerals can be traced back to the original biomolecules and biomacromolecules. The extent of alteration depends on both the rank of the coal and the type of maceral, some of which are more resistant than others. Data from the analysis of whole coals and separated coals will be discussed. 22 refs., 17 figs., 6 tabs.

39826 (DOE/PC/79907–T6) **Spectroscopic study of coal structure and reactivity: Quarterly report, April 1, 1989–June 30, 1989.** Griffiths, P.R. California Univ., Riverside, CA (USA). Dept. of Chemistry. 30 Jun 1989. 121p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79907. Order Number DE89015855/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Work continued on several projects supported by this grant. A brief description of each project follows. (1) Combined Deconvolution and Curve-Fitting; (2) Depth-Profiling using a Step-Scanning Interferometer: The instrument is in its final stages of construction. We recently added a piezoelectric transducer to the moving mirror drive to compensate for the effect of thermal drift and the mirror position is now stable to better than ± 1 nm for several seconds; (3) Combined Thin-Layer Chromatography and FT-IR Spectrometry of Coal Extracts: This work is now essentially complete; (4) Characterization of Matrices for Infrared Diffuse Reflectance Spectroscopy; and (5) Combined Supercritical Fluid Chromatography and FT-IR Spectrometry of Coal Extracts.

39827 (EUR–11845, pp. 117-121) **Adsorption and desorption phenomena of polycyclic aromatic hydrocarbons on fly ash.** Rodenburg, L.J.M. (TNO Division of Technology for Society, Delft (Netherlands)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

In this paper the results of vacuum sublimation experiments are presented and discussed. Vacuum sublimation experiments show that only low concentrations of PAH can be detected in six of the seven fly ashes under investigation. Sublimation at high temperature (175 C) leads to a decrease of the extraction efficiency in comparison with sublimation at 60 or even at 30 C. Although the cause of this effect has not been investigated, it is probable that chemical conversion of the the PAH on the fly ash surface gives rise to this phenomenon. The fly ash with considerable amounts of PAH deviates from this behaviour, i.e. the collected amounts of PAH are higher at 175 C than at 60 or 30 C. 2 refs., 3 figs., 2 tabs.

39828 (EUR–11845, pp. 122-131) **Adsorption and desorption phenomena of polycyclic aromatic hydrocarbons on fly ash.** Klemm, K. (Bergbau-Forschung GmbH, Essen (Germany, F.R.)); Liphard, K.G. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW, Suite 707 Washington, DC 20037.

Previous research in this project dealt mainly with Soxhlet extraction in general and related work such as purification of solvents and extracts, testing several solvents in terms of extraction power to PAH, stability at boiling point and selectivity. Previously used solvents were methanol, dichloro-methane, trichloromethane, tetrachloromethane, cyclohexane, benzene, toluene, all xylenes, mesitylene, tetralin, tetrahydrofuran and acetic acid. Additional investigations to separate PAH from fly ash such as ultrasonic extraction and sublimation have been applied. The special refractory desorptivity of PAH from fly ash, derived from fluidized bed combustion, made it necessary to get some more information about the surface structure. For this reason the fly ash was investigated by electron microscopy. To improve contact to solvents, crushing by the pressure drop method has been performed. 1 ref., 7 figs.

39829 (EUR–11846, pp. 3-15) **Ultrasonic spectroscopy of CWM fuels.** Griffin, G.J.L. (Brunel University, Egham (United Kingdom). Ecological Materials Research Institute); Pope, P.H.; Griffin, W.G. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

A report is presented of work carried out on applications of ultrasonic techniques to CWM fuels. Apparatus was set up for making pulse velocity and attenuation measurements over a range of frequencies. The properties of shear waves at low frequencies in CWM were studied. The system would be amenable to adaptation to simultaneous temperature and acoustic measurement with real-time computer correction of the data. Such a system could form the basis of a non-invasive pipeline device for the continuous observation of CWM properties provided that enough data are collected on the variations in the acoustic properties of coal itself. 2 refs., 5 figs., 1 tab.

39830 (INIS-mf–11495, pp. 166-168) **Trace elements in Swiss coals.** Fardy, J.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Energy Chemistry); Hugi, T.; Swaine, D.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The concentrations of La, Ce, Nd, Sm, Eu, Tb, Dy, Yb and Lu in Swiss anthracitic coals and brown or lignitic coals were determined by instrumental neutron activation analysis (INAA). In general, the ranges and mean values for the anthracitic coals were close to those for North American anthracites and for Australian bituminous coals. For the brown or lignite coals the ranges and mean values for La, Ce, Nd, Sm and Eu were similar to those for the anthracitic coals and Australian bitumous coals, whereas Tb, Dy, Yb and Lu had lower values. It is postulated that the REE are predominantly associated with the mineral matter in Swiss coals.

39831 (INIS-mf–11495, pp. 175-177) **Monte Carlo model of a COALSCAN pair production ash gauge.** Rainbow, M.T. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A computer model of a COALSCAN pair production ash gauge has been developed. It utilises Monte Carlo methods to model gamma ray transport. Results obtained to date indicate that some model predictions compare favourably with actual gauge behaviour.

39832 Numerical comparisons between the pyrolysis mass spectra of twelve US coals and their relative solubility in microbial cultures or alkaline buffer. Yeh, G.J.C. (Idaho National Engineering Lab., Idaho Falls (USA)); Ward, B.; Quigley, D.R.; Crawford, D.L.; Meuzelaar, H.L.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 612-622 (1988). DOE Contract AC07-76ID01570. (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Curie-point pyrolysis mass spectra of twelve low-rank US coals with various degrees of natural weathering were correlated with the results of biosolubility screening tests involving six selected microorganisms as well as with a specially designed alkaline solubility test. The main objective of this study was to determine which mass spectral characteristics, if any, correlate with the degree of biosolubility. The results indicate the possible presence of two biosolubilization trends, a main trend which correlates positively with the presence of severely oxidized aromatic moieties in the coal and apparently enables biosolubilization by all six microorganisms, and a second trend which correlates with relatively high concentrations of acid components and enables biosolubilization by only two or three of the organisms. The chemical and biological significance of these trends is not yet completely understood. Finally, in agreement with previous reports a strong positive correlation was observed between biosolubility and alkaline solubility.

39833 Characterization of biodegraded coals. Bean, R.M. (Pacific Northwest Lab., Richland, WA (USA)); Franz, J.A.; Campbell, J.A.; Linehan, J.C.; Stewart, D.L.; Thomas, B.L. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 657-664 (1988). DOE Contract AC06-76RL01830. (CONF-8809269–: Bioprocessing of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Microbial degradation of coals to materials that are soluble in water has been a topic of intensive research for the last few years. The potential for economical recovery of low-grade coals, coupled with possibilities for further upgrading by microbial desulfurization or methanation has spurred intensive research at a number of laboratories. Until very recently, coal biodegradation has been accomplished using low-grade, naturally oxidized coals such as leonardiate, or coals subjected to pretreatment with oxidizing chemicals. The authors have been able to accomplish the biodegradation of bituminous Illinois #6 coal after a pretreatment consisting of air oxidation, using a culture of the fungus Penicillium sp. They report in this paper results of chemical and spectrometric analyses of the starting materials and products from Illinois #6 coal biodegradation, and compare the results with those previously reported from the biodegradation of leonardite.

39834 Diffuse reflectance infrared spectroscopy studies of the air oxidation of coal surfaces. Fuller, E.L. Jr. (Oak Ridge National Lab., TN (USA)); Smyrl, N.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 691-698 (1988). (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Oxidation of coals is of concern to those interested in the weathering that begins as soon as the mined material is wrested from the humid, reducing, pressurized environment of the underground seam. The loss of energy content comprises an obvious economic impact to combustion processes. Floculation and coking processes are both deleteriously effected whereas systematic information regarding the structure and reaction mechanisms can be obtained. This work is directed primarily to defining the surface structures and mechanisms occurring at the air/coal interface.

39835 ESCA study of alkali-treated coal surfaces. Baltrus, J.P. (Pittsburgh Energy Technology Center, PA (USA)); Diehl, J.R.; D'Este, J.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 723-728 (1988). (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

The surface interactions of alkali with coal and mineral matter have been studied by ESCA to establish a basis for predicting the relative reactivity of alkali with sulfur during coal beneficiation processes. The speciation of sulfur in several coals doped with various alkali salts was determined and quantified following heating of the samples to 375°C in air or N_2 and after washing them with water. Organic and pyritic sulfur react with the alkali cation when heated, after which the sulfide or oxidized sulfur product can be washed from the coal. The extent of reaction between the alkali salt and sulfur is governed by the size of the cation and the electronic properties of the anion; larger alkali cations are more reactive, as are anions with stronger nucleophilic properties.

39836 Characterization of coal particle surfaces by film flotation. Fuerstenau, D.W. (Univ. of California, Berkeley (USA)); Diao, J.; Hanson, J.S. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 748-755 (1988). DOE Contract FG22-86PC90507. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Because of the heterogeneity of coal, particles may vary in composition and, consequently, each particle may have its own unique set of surface properties. The distribution of surface properties of coal particles was determined through film flotation with a series of aqueous methanol solutions. This paper shows how such measurements of the critical wetting surface tension can be used to determine the contact angle of particles and the distribution of lyophobic sites on the surface of the particles. The mean contact angles calculated from film flotation results for sulfur, graphite and a number of different coals are in reasonable agreement with the values reported in the literature.

39837 Characterization of mineral and coal surfaces by adsorption of dyes. Slomka, B.J. (Iowa State Univ., Ames (USA)); Dawson, M.R.; Buttermore, W.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 797-803 (1988). DOE Contract W-7405-ENG-82. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

A dynamic method is described for dye adsorption measurements to characterize mineral and coal surfaces for the evaluation of coal cleaning processes. Samples of increasing mineral content were prepared by density separation of a narrowly sized (300 to 425 μm) wet-sieved coal. The rates and extents of the adsorption of ionic dyes on Illinois No. 6 coal were observed to be highly dependent on mineral content and particle size of ground coal samples. A linear correlation was observed between the adsorbed quantity of dye and the total mineral content of coal samples. Dry-sieved coals were found to be coated by fine material of high mineral ash content which adsorbed greater than 20 times more methylene blue per gram than wet-sieved particles. In preliminary experiments with methylene blue dye, clay was found to adsorb significantly more dye than quartz, pyrite, calcite or low-ash specific gravity fractions of coal.

39838 Assessment of the hydrophobicity of fine coal particles in various aqueous media by viscosity measurements. Tampy, G.K. (Iowa State Univ., Ames (USA)); Birlingmair, D.H.; Burkhart, L.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 804-810 (1988). DOE Contract W-7405-ENG-82. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Viscosity measurements have been shown to provide a good indication of the relative hydrophobic and hydrophilic nature of fine coal particles in various aqueous media. Slurries of float and sink fractions of pulverized Upper Freeport run-of-mine coal in various electrolytes showed evidence of structure formation under the influence of shear. This structuring reaches a steady state at very high shear rates; by examining the viscosities at the higher shear rates, the inter-particle interaction effects and hydrodynamic effects may be distinctly determined. When the particles are more hydrophobic, the tendency for structure formation is greater. This is reflected in the response of the slurry to shear. Viscosity measurements of α-alumina particles in slurries of various pH, and corresponding zeta potential measurements, confirmed that the highest viscosity and the maximum structure formation occurred at the PZC, when the particle surfaces are most hydrophobic.

39839 Hydrophobic character of pretreated coal surfaces. Jin, R. (Univ. of Utah, Salt Lake City (USA)); Ye, Y.; Miller, J.D. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 811-817 (1988). DOE Contract FG22-85PC80530. (CONF-8809271–: Surface chemistry of coal, Los Angeles, CA (USA), 25-30 Sep 1988).

Increased hydrophobicity and hence the flotability of coals of different rank has been observed for CO_2 pretreatment and/or controlled thermal pretreatment. DRIFT- and ATR-FTIR and XPS techniques have been used to determine the surface chemical characteristics in order to evaluate coal hydrophobicity. These results agree very well with those determined by traditional methods. The enhanced hydrophobicity of CO_2-treated coal is attributed to the high specific affinity of coal for CO_2 which results in the displacement of pore water and hydration water by CO_2 and on pressure release leads to nanobubble formation at the coal surface in aqueous suspension. Increased hydrophobicity of lignite by thermal treatment arises from the removal of pore water, hydration water and some organic OH functional groups as well as the diffusion of volatile matter to the surface and the reorientation of surface functional groups.

39840 Effect of moisture on the diffusion of organic molecules in coal. Otake, Y. (Brown Univ., Providence, RI (USA)); Suuberg, E.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 898-905 (1988). DOE Contract FG22-85PC80527;AC21-84FC10617. (CONF-8809228–: American Chemical Society Division of Fuel Chemistry meeting, Los Angeles, CA (USA), 25-30 Sep 1988).

The results of the present study confirm the importance of establishing and reporting carefully the moisture content of any coal that

is the subject of diffusion rate and/or swelling rate measurements. Likewise, it is important to report carefully how a sample may have been dried, prior to these measurements, since such low temperature procedures also may influence the results. It may be concluded from the present work that moisture will swell coals of bituminous, subbituminous, and lignite ranks. This swelling will permit faster penetration and swelling of the coal structure by organic liquid diffusants. The activation energies observed for such swelling processes are reduced, as the effective glass transition temperature of the coals are increased, either by drying or pyrolysis.

39841 Identification of labile-hydrogen functionalities in coal-derived liquids by ^{31}P NMR spectroscopy. Lensink, C. (Ames Lab., IA (USA)); Verkade, J.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 906-912 (1988). DOE Contract W-7405-ENG-82. (CONF-8809228–: American Chemical Society Division of Fuel Chemistry meeting, Los Angeles, CA (USA), 25-30 Sep 1988).

In recent publications from this laboratory, the application of ^{31}P Fourier transform NMR spectroscopy to the analysis of -OH, -NH and -SH functionalities in coal extracts and pyrolysis condensates has been described. The authors indicated these studies with a series of reagents which contain two oxygen atoms in the five-membered phospholane ring system, and varying degrees of ring substitution. To determine the role of the heteroatoms within the ring system of the reagent and the size of the ring system, the authors are extending their investigations to include reagents such as Cl-P-$(NMe)_2$ 5-membered ring, Cl-P-S_2 5-membered ring, and Cl-P-S_2 6-membered ring. Here they describe the preliminary results with a series of model compounds derivatized with these reagents, and also with a coal low-temperature pyrolysis condensate.

39842 Effects of pyrolysis conditions on the macropore structure of coal chars. Zygourakis, K. (Rice Univ., Houston, TX (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 951-959 (1988). DOE Contract FG22-87PC79930. (CONF-8809228–: American Chemical Society Division of Fuel Chemistry meeting, Los Angeles, CA (USA), 25-30 Sep 1988).

The operating conditions influencing most strongly the pyrolysis process are the heating rate, the particle size and the pressure. Existing literature data offer little quantitative information on the effect of operating conditions on macropore structures, since the majority of past studies have concentrated on studying the kinetics of pyrolysis reactions and the distributions of the obtained products. Previous studies, however, indicate that the kinetic and transport processes occurring during pyrolysis (such as the rate of volatile release, the diffusion of volatiles into the bubbles, the transport of volatiles to the particle exterior etc.) will be governed by the time-temperature history of the coal particles. Hence, the pyrolysis heating rate is expected to have the strongest effect on the macropore structure of the chars. This paper discusses the effects of pyrolysis heating rate and particle size on the macropore structure of chars and described the modeling of char gasification.

39843 Coal gel chemistry. 1. An aspect of synergistic effects on the solvent swelling of coal. Aida, T. (Kinki Univ., Kyushu (Japan)); Shimoura, Y.; Yamawaki, N.; Fujii, M.; Squires, T.G.; Yoshihara, M.; Maeshima, T. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 968-974 (1988). DOE Contract W-7405-ENG-82. (CONF-8809228–: American Chemical Society Division of Fuel Chemistry meeting, Los Angeles, CA (USA), 25-30 Sep 1988).

Although it has long been pointed out that there was a correlation between the increase of extractability and the increase of swelling, the mechanism of the synergistic effect on the solvent swelling of coal has been controversial in the coal chemistry. Recent, the authors revealed the significant steric requirement on the solvent swelling of coal. In the course of the further study on the solvent swelling of coal. In the course of the further study on the solvent swelling by using various solvents they have learned that there was a curious similarity on the solvent systems adopted by previous researchers, which were commonly composed of a sterically hindered and a less sterically hindered solvents, and also have found that the relaxation of the steric requirement of coal by the initial formation of the Coal Gel of a less hindered solvent would be responsible to the synergistic effect on the solvent swelling of coal. This paper presents the results of the studies on the synergistic effects of binary solvents on the solvent swelling of coal, based on the steric requirement.

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Refer also to citation(s) 39803, 39823, 39827, 39828, 39870, 39875, 39876

39844 (BHRA-RR–2376) **Hydraulic transport of gasifier slag.** Grove, T.W. British Hydromechanics Research Association, Cranfield (UK). Feb 1985. 69p.

The work described in the report was carried out on behalf of the British Gas Corporation-S.N.G. Group and was the first stage of a proposed three stage investigation into the feasibility of hydraulically transporting gasifier slag produced as a by product from a 2000 MW power station. Preliminary laboratory investigations used bench scale tests to provide a computational estimate of performance characteristics. The laboratory data were used as input variables to a BHRA computer program which predicted pipeline losses for a given range of solids throughput, slurry concentrations and pipe diameter.

39845 (CONF-8906177–1) **Clean coal technology waste characterization.** Peters, R.W.; Wentz, C.A. Argonne National Lab., IL (USA). 1989. 27p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract W-31109-ENG-38. From 21. mid-Atlantic industrial waste conference; Harrisburg, PA (USA); 25-27 Jun 1989. Order Number DE89015136/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Clean coal technologies signify a new generation of highly efficient, environmentally clean, coal-based energy processes. The US Department of Energy (DOE) has a Clean Coal Technology Program, which has a major goal of improving the options available to reduce emissions from coal-fired power plants. To accomplish this goal, DOE is pursuing the development and demonstration of technologies that will result in more efficient and effective emission controls. This paper summarizes the available data on the characteristics of the solid wastes from these various clean coal technologies, with particular emphasis on waste as defined in the Resource Conservation and Recovery Act (RCRA) and coal gasification. The available data indicate that the majority of solid wastes resulting from these technologies would not be classified as hazardous under RCRA standards. 29 refs.

39846 (DOE/FC/10619–2724) **Microbial degradation of polycyclic aromatic hydrocarbons under denitrification conditions in soil-water suspensions: Final report.** Mihelcic, J.R.; Luthy, R.G. Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering. Apr 1988. 196p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-84FC10619. Order Number DE89011690/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The microbial degradation of polycyclic aromatic hydrocarbons (PAH) under different redox conditions was examined for soil-water suspensions, with particular emphasis on microbial degradation under denitrification conditions. Batch microbial degradation tests of naphthol, naphthalene, and acenaphthene with 1 gram of soil per 50-ml aqueous phase were conducted under aerobic and anaerobic conditions. A conceptual model was proposed to describe the aqueous-phase concentration of PAH solute under denitrification conditions for soil-water systems maintained under gentle suspension. The approach combined an intra-aggregate radial diffusion model to represent solute sorption and desorption with soil, with either Monod or first-order kinetics to describe the microbial degradation of solute from the bulk-aqueous phase. The microbial degradation of naphthalene in soil-water suspensions under denitrification conditions was modeled by the coupled desorption-degradation approach in order to evaluate unexplored situations in which soil particle size may affect the rate of microbial degradation. A preliminary assessment of the effect of solute hydrophobicity on microbial degradation was modeled for volumetric mean particle radii in the range of 0.01 to 0.1 cm. The coupled desorption-degradation model and first-order aerobic degradation kinetic information from the literature used to predict the aqueous- and sorbed-phase concentrations for the solutes naphthalene, anthracene, and benzo(a)pyrene. 43 refs., 53 figs., 10 tabs.

39847 (DOE/PC/88850–T1) **Fundamental investigation of duct/ESP phenomena: Literature review: Topical report No. 1.** Peterson, J.R.; Durham, M.D.; Vlachos, N.S. Radian Corp., Austin, TX (USA). 9 May 1989. 210p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88850. Order Number DE89014128/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The purpose of this study is to obtain a better understanding of the basic physical and chemical phenomena that control: (1) the in-duct desulfurization of flue gas by various calcium-based sorbent materials, and (2) the coupling of an existing ESP particulate collection device to a duct-injection process. The purpose of this literature review is to critically review the work that has been completed on the duct-injection process and to generate background information on the physical and chemical phenomena associated with duct-injection technology. This review encompasses both experimental data and the computer modelling of the duct-injection/ESP phenomena. 285 refs., 29 figs., 10 tabs.

39848 (DOE/PC/88873–T3) **Global approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly progress report No. 3.** Energy and Environmental Research Corp., Irvine, CA (USA). 13 Jun 1989. 52p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88873. Order Number DE89015763/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

During this quarter studies have evaluated the reactivity of $Ca(OH)_2$ slurry droplets in an environment at 100 percent relative humidity and 60°C. Parameters included the influence of droplet size, SO_2 concentration, and sorbent slurry concentration. Extensive quality assurance checks on the solids sampling and analytical techniques have been conducted. Sorbent utilization was not strongly influenced by droplet size or SO_2 concentration, but decrease markedly with increasing slurry concentration at the short residence times investigated. Under the modeling task a new version of the in-duct FGD process model has been developed. The improved model contains more complete descriptions of the evaporation process and of the SO_2-slurry droplet reaction. Included in the reactivity submodel are steps describing the ionization of H_2SO_3, liquid phase diffusion, and the dissolution of calcium at the sorbent surface. The model also calculates the position and rate of diffusion of sorbent particles within the droplet. The sorbent dissolution rate is the only adjustable parameter, and this value will be determined from comparisons with experimental data. Satisfactory operation of the model has been verified in several sensitivity studies. 2 refs., 21 figs.

39849 (DOE/PC/88943–T1) **N_2O formation in combustion systems: Quarterly technical progress report.** Fossil Energy Research Corp., Laguna Hills, CA (USA). Jun 1989. 15p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88943. (QR–7020-1). Order Number DE89015768/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this project is to characterize N_2O emissions from combustion sources emphasizing N_2O emissions from post-combustion selective gas phase NO_x reduction processes and reburning. The processes to be evaluated include ammonia, cyanuric acid, urea injection and reburning. The project includes pilot-scale testing at two facilities supported by chemical kinetic modeling. Testing will be performed on both a gas-fired plug flow combustor and a pulverized-coal fired combustor. Work performed has included the performance of preliminary chemical kinetics calculations. This work was done using a PC-based version of Sandia Laboratories CHEMKIN kinetics code. Following completion of the initial kinetics runs, laboratory work will begin in the gas-fired facility. Following completion of the first phase of that work, both testing at the coal-fired facility and additional kinetics calculations will be performed. 10 refs., 4 figs., 2 tabs.

39850 (EA–1989-1) **An evaluation of alternative control strategies to remove sulfur dioxide, nitrogen oxides and carbon dioxide at existing large coal-fired facilities.** American Gas Association, Inc., Arlington, VA (USA). Jan 1989. 30p. Available from American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 (USA).

Compares the ability of 15 different control options to reduce emissions of the named pollutants in response to concerns over acid rain, urban ozone and other problems. The options have a wide range of possible costs depending on specific site characteristics. Five involve the use of some natural gas: gas cofiring, gas reburn and reburn with sorbent injection, and repowering with a gas boiler or combined cycle unit. Only the gas options simultaneously reduce all three pollutants, and gas-based options are cost competitive.

39851 (EUR–11845) **Flue gas and fly ash.** Sens, P.F.; Wilkinson, J.K. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). 1989. 181p. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988).

15 papers are presented in sections on flue gas treatment, and fly ash properties, re-use and disposal. The papers are all research reports of work carried out in the 'Utilization of Solid Fuels' research programme, performed under the supervision of Directorate General XII for Science, Research and Development of the Commission of the European Communities. All papers have been abstracted separately.

39852 (EUR–11845, pp. 3-14) **Catalytic NO_x reduction.** Tuenter, G. (Netherlands Energy Research Foundation, Petten. Dept. of Chemistry and Materials Science); Muller, H.G.P.; Snepvangers, L.J.M. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW, Suite 707 Washington, DC 20037.

The aim of the project is to evaluate the perspective of a modified selective catalytic reduction process to reduce NO_x emissions from flue gas. In a previous study the activity of the equimolar NO/NO_2 reduction was found to be higher than the NO reduction. The modified process is based on the equimolar NO/NO_2 reduction. NO, being the predominant NO_x component in flue gas from stationary sources, must then be partly oxidized to NO_2. A desk study is carried out to review the literature on methods for flue gas composition modification with respect to the NO/NO_2 ratio. The evaluation of the modified SCR process also requires more knowledge about the increase in catalytic activity of the equimolar NO/NO_2 reduction as compared to the NO reduction and about the effect of catalyst composition on the reaction rate. In order to investigate these aspects, an experimental programme is carried out, using four different catalyst materials; two commercial preparations and two self-prepared vanadium-titanium dioxide catalysts. The results of activity measurements for NO, NO_2 and the equimolar NO/NO_2 reduction are reported, under conditions relevant for large scale applications. From these results some preliminary conclusions can be drawn with respect to the perspective of the modified process. 6 refs., 6 figs., 6 tabs.

39853 (EUR–11845, pp. 15-20) **Improved gas filtration systems for control of solid fuel particulate emissions.** Cromwell, P. (Irish Science and Technology Agency, Dublin (Ireland)); Doyle, A.; Kennedy, A.D.; O'Rourke, K. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW, Suite 707 Washington, DC 20037.

A theoretical analysis of the problems associated with the filtration and rapid combustion of carbonaceous smoke in systems which can tolerate only extremely low resistance to gas flow was carried out. Discussions were held with a range of commercial suppliers. A number of potentially suitable filters were identified, some of these have been acquired, others will be acquired in the near future. Two pilot test installations and all of the associated instrumentation were commissioned. Pilot installation No. 1 is an open type system and installation No. 2 is a closed type system. The most appropriate smoke emissions measuring equipment was identified and fabricated. This latter equipment has now been commissioned. The relevant operating characteristics of the pilot systems (gas flows, temperatures, etc.) were determined for three typical solid fuel types - high volatile coal ('Texan' coal), medium volatile coal ('Polish' coal) and peat briquettes. Preliminary trials with some filter systems in place have been carried out. 3 tabs.

39854 (EUR–11845, pp. 21-32) **Development of a process for removal of SO_2 and NO_x from flue gas using brown coal coke.** Lenz, U. (Rheinische Braunkohlenwerke AG, Koeln (Germany, F.R.)); Paeffgen, H.P.; Wolfrum, E. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW, Suite 707 Washington, DC 20037.

The object of the research project is to confirm and extend in systematic laboratory tests the results thus far obtained with the use of brown coal coke for removing NO_x and SO_2 from flue gases. It has been proved that brown coal coke is an efficient adsorber/catalyst for dry flue gas cleaning. The removal of NO_x and SO_2 largely depends on the residence time of the flue gas in the coke fill and on its moisture content. NO_x removal requires residence times of 15 to 20 seconds (referred to an empty pipe). The investigations in the field of SO_2 removal were performed with a residence time of 8 seconds which led to a maximum SO_2 adsorption of approx. 20% wt. A rise in flue gas moisture reduces the coke's NO_x removal efficiency while it increases the SO_2 removal rate. Possible applications of brown coal coke are seen in small generating units and in large power plants where desulfurization facilities have already been installed. In the former case brown coal coke can be used for complete desulfurization and for NO_x removal, in the latter one, however, it serves the purposes of residual desulfurization and NO_x removal. Brown coal coke's big price advantage over other activated cokes, e.g. those produced from hard coal, makes an expensive regeneration of the laden coke superfluous. It can be used as a fuel with a high heating value in power plants equipped with flue gas desulfurization facilities or as a valuable sulfur-containing material in other appropriate plants. 11 figs.

39855 (EUR–11845, pp. 73-80) **Electromulticyclone for coal burner exhaust gas cleaning.** Dumont, J.N. (Bertin et Cie, Plaisir (France)); Aulard, P.; Vendel, J.; Ramel, M. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

Following a former project where a tangential entry electrocyclone was built and tested, the present project deals with the demonstration of economic and technical validity of an electromulticyclone for coal burner exhaust gas cleaning. The first phase of the project is being completed. A single cell of electrocyclone, adapted from a commercial multicyclone cell, was built and tested in laboratory and industrial conditions. Electric insulation was improved, electrode geometry optimized, and a rapping defouling device was installed and tested. Results show that electrostatic collection efficiencies of 50% to 80% could be attained with modified cyclones where residence time would be increased. 4 refs., 9 figs.,

39856 (EUR–11845, pp. 89-102) **Pulse power techniques for flue gas treatment.** Dinelli, G. (ENEL, Rome (Italy)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

The narrow pulse energization of the flue gas of thermal power plants appears a promising technology for the abatement of solid particulates as well as the sulphur and nitrogen oxides. The research conducted on pilot installations and on a 35 MWe industrial precipitator, has a potential for the improvement of the design and operational flexibility of the equipment as well as for energy saving. The results of the experiments conducted on a 10.000 Nm^3/h pilot ESP have evidenced the interest on enlarging the collection plates distance from 300 mm to 400 mm. Those conducted on the industrial ESP have confirmed the substantial reduction of the solid particle emissions obtainable, at an assigned specific collection surface, with the impulse energization compared to the conventional energization. The tests on the electrochemical oxidation of the nitrogen and sulphur oxides, carried out with 1000 Nm^3/h reactor cells, have evidenced a removal efficiency of 50 to 60% for the nitrogen oxides and of 80 to 90% for the sulphur oxides. 9 figs., 7 tabs.

39857 (EUR–11845, pp. 105-116) **Characterisation of fly ash from fluidised bed combustors with regard to its utilisation and safe disposal.** Gay, A.J. (Netherlands Organization for Applied Research TNO, Delft); Frigge, J. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

The growing use of fluidised bed combustion (FBC) for generation of electrical power and heat results in a large increase of the amount of residues (fly ash and spent sorbent). These solid residues have very different properties from those of fly ash from conventional power plants. Therefore the characterisation of the FBC residues, with respect to their safe disposal and to their eventual utilisation, is of prime importance. Tests giving a realistic approach to the study of leaching behaviour of the residues are described. Results of analysis (carbon, sulphur, major- and-trace-elements) are discussed. Morphology, particle size distribution and enrichment effects on single particles are dealt with. A method for the comparison of the results of different leaching tests is presented. 16 refs., 6 figs., 7 tabs.

39858 (EUR–11845, pp. 158-160) **Handling and conditioning of fluidized bed and pulverized coal boilers fly-ash for landfill disposal and re-use.** Blondin, J. (CERCHAR, Rueil-Malmaison (France)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

Dry landfill disposal of fly ash and bottom ash from Power Plants has been widely used for years without problems. The possibilities of using the freshly produced or reclaimed material have been extensively studied and a significant portion of fly ash is used for road works, cement manufacture or concrete additives. The emergence of new technologies such as fluidized bed combustion with calcium additives for desulfurization; pulverized coal combustion in small capacity boilers and furnaces; dry limestone injection in the combustion chamber of pulverized coal or stoker boilers gives rise to a new kind of fly-ash the characteristics of which may be different as regards properties, landfill disposal and reuse. The aims of this research are to provide information about these new types of fly-ash, to define the best practices for handling and landfill disposal and to promote valorisation.

39859 (NEI-DK–177) **Deformation and frost-resistant characteristics of desulfurization products.** Energiministeriets Energiforskningsprogram. Miljoe og restprodukter. Foged, N.; Joens, E. (eds.). Geoteknisk Inst., Lyngby (Denmark); Niro Atomizer A/S, Soeborg (Denmark). Feb 1989. 83p. (In Danish). Order Number DE89902273/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Energiministeriets Energiforskningsprogram. Miljoe og restprodukter.; EFP-83.

By-products from the desulfurization (using spray drying absorption) of emission from an American power station have been utilized in the production of synthetic gravel consisting of water and the aforementioned by-products merely. Tests showed that the elasticity of the gravel did not exceed 120 NM/mp2. The syntehtic gravel proved to be insensitive to frost. (AB).

0109 Environmental Aspects

Refer also to citation(s) 39803, 39845, 39849, 40866

39860 (EUR–11797) **Carbon dioxide and other greenhouse gases: climatic and associated impacts.** Fantechi, R.; Ghazi, A. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). 1989. 288p. (CONF-8611146–: Commission of European Communities symposium on CO_2 and other greenhouse: climate and associated impacts, Brussels (Belgium), 3-5 Nov 1986).

22 papers were presented under the following session headings: opening session; observations, carbon cycle and projections; expected climatic change; and expected impacts. Each session is preceded by a report on the session.

39861 (EUR–11845, pp. 132-157) **Waste/soil interaction studies - the leaching of molybdenum from pulverized coal ash.** Sloot, H.A. van der (Netherlands Energy Research Foundation, Petten); Hjelmar, O.; Groot, G.J. de. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW, Suite 707 Washington, DC 20037.

In this work the leaching of molybdenum from pulverized coal ash illustrated the similarities between a number of leach test procedures. It highlights the usefulness of the different methods in obtaining information to assess the release and fate of potentially hazardous components from waste materials in the soil system. For this purpose, column leaching tests, batch extraction procedures, lysimeter measurements, diffusion measurements, measurements of the interaction at the waste/soil interface and migration measurements at low percolation rates have been carried out. The combined information from these methods leads to a more detailed insight into the factors relevant to the impact assessment of undesirable components from combustion residues. The sequence of diffusion, interface interaction and migration measurements using radiotracers yields valuable information about the behaviour of the stable elements, which is difficult to gain from conventional techniques. The simplicity of the procedure and the versatility in studying the influence of variations in relevant parameters (e.g. pH, complexing capacity, redox) offers a great potential in tackling the complex phenomena occuring in waste/soil systems. 26 refs., 12 figs., 4 tabs.

39862 (SNV–3568) **Impact of anthropogenic activities on the global N_2O cycle.** Rodhe, H.; Johansson, C. Statens Naturvaardsverk, Solna (Sweden). Tekniska Avdelningen. 1989. 19p. (In Swedish). Available from Statens Naturvaardsverk, Solna (Sweden). Tekniska Avdelningen.

Nitrous oxide (N_2O) is a stable molecule with an atmospheric lifetime of approximately 100 years. Its concentration in the atmosphere is increasing with a speed of 0.3% per year. As N_2O has an important role in determining the ozone concentration in the stratosphere and is an important greenhouse gas, the observed increase is worrying. This report contains a short summary of the present knowledge of the global N_2O cycle, with emphasis on present and potential future anthropogenic impacts on this cycle.

0110 Reserves and Exploration

Refer also to citation(s) 39807, 40834

0130 Transport and Handling

Refer also to citation(s) 39781

39863 (CONF-8905189–1) **Status of colloraborative research in the solid transport area between Midwest Universities and Argonne National Laboratory.** Sha, W.T.; Adrian, R.J. Argonne National Lab., IL (USA). 1989. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From USDOE/Pittsburgh Energy Technology Center contractors review meeting; Pleasanton, CA (USA); 16-18 May 1989. Order Number DE89015163/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Collaborative research on the transport of solids is briefly reported. Research areas include: computational analysis, interfacial phenomena and dynamics of bubble wakes in gas-liquid-solid flows, interfacial phenomena in solid fluid systems, experimental and modeling studies of particle-fluid-wall interaction mechanisms and influence on heat transfer pressure drop in slurry pipe and jet flows, dynamics of turbulent, dense, solid-gas flows, and investigation of particle motion in multiphase flows by optical and x-ray imaging techniques. 6 refs., 18 figs. (CBS)

39864 (DOE/PC/80524–T15) **Pipe and bend erosion by pneumatic transport of solids at high temperature: Final report.** Klinzing, G.E.; Borzone, L.A.; Yang, Wen-Ching. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering; Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center. Jun 1989. 217p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80524. Order Number DE89015741/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

The erosion of various components of a pneumatic transport line has been studied through basic experiments, commercial-scale test runs and computer simulation. The main objective was to study the effect of the operating variables on the erosion rates of refractory lined straight sections and bends. Temperatures ranging from 22 to 830°C, gas velocities from 12.9 to 34 m/s and solid flow rates from 48 to 225 kg/h were tested in a High Temperature Pneumatic Transport Test Facility. Four kinds of refractory concretes were used as targets. The erodent materials were river sand, coal slag and alumina. The effect of gas velocity and solids slow rate on the erosion rate was correlated in terms of power laws, while temperature effects proved to be more complex, since mechanical properties of both erodent and target materials change with temperature. The erosion of circular bends was evaluated using a computer model that combines computational particle dynamics and experimental data to predict the erosion pattern inside the bend. Experiments on the erosion of wedge samples, performed in the erosion test facility, and data on particle-wall collisions, obtained with the help of high-speed photographic techniques, were the basic set of data used in the simulation. As an alternative to circular radius bends, and experimental study of wear and flow patterns in blinded T-bends was performed. The internal geometry in this kind of bends was determined by the solids deposition, and complex erosion patterns appeared as the operating variables were manipulated. 81 figs., 50 tabs.

39865 (EUR–11846, pp. 49-55) **Coal water mixtures pulverization study.** Myrope, A. (CERCHAR, Rueil Malmaison (France)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Since the development of coal water fuels and burners, the importance of air atomizing has been demonstrated. Twin fluid atomizers can generate combustion without use of auxiliary fuel but complex correlations between spray quality, design nozzle geometry and CWF properties are still a matter of discussion. The objective of the present investigation was to consider how atomizer geometry (fully internal and external/internal) influences the atomization during cold spray tests with one type of coal. Then, one nozzle was chosen to investigate the influence of CWF quality. The principle of laser beam diffraction has been used for spray characterization. The program also included quick cinematography and quick photography investigations to get a look at spray shapes and speeds at nozzle exit. 7 refs., 5 figs., 1 tab.

39866 (EUR–11846, pp. 56-65) **Advanced atomiser development for coal water slurry combustion.** Welbourne, M.C. (NEI International Combustion Ltd., Derby (United Kingdom)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service, 2100 M St., NW Suite 707, Washington, DC 20037.

This report describes work on a number of projects carried out in parallel and designed to improve the understanding of the behaviour of slurry fuels in atomisers and burners. The results from each will be integrated and incorporated into the design of an improved slurry burner. Test work to date was concentrated on the isothermal development of a prefilming atomiser, where simulant fluids have been used to establish the atomisation and flow characteristics for a wide range of fuel quality. It was found that non-Newtonian fluids have produced coarser sprays than could be predicted from their actual viscosity so an alternative rheological property is being considered to attempt to explain the differences. Supporting development of the burner aerodynamics has been made by measurement of the combustion airflow and turbulence in the near

burner region to understand the highly turbulent mixing zones which contribute to flame stability and combustion efficiency. 6 figs.

0140 Combustion

Refer also to citation(s) 39852, 39853, 39854, 39855, 39857, 39862, 39865, 39866, 40430

39867 (ANL/FE–89/1) **Measurement of alkali metal vapors and their removal from a pressurized fluidized-bed combustor process stream: Annual report, October 1987–September 1988.** Lee, S.H.D.; Carls, E.L. Argonne National Lab., IL (USA). Jun 1989. 58p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE89014365/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The alkali vapor in the hot process stream from a pressurized fluidized bed combustor (PFBC) could cause corrosion problems with the turbine blades. A series of experiments with a laboratory-scale PDBC/alkali sorber unit is underway (1) to measure the alkali vapor (Na and K) concentration in a PFBC process stream and (2) to demonstrate the granular-bed sorber concept for the removal of alkali vapors from the hot PFBC process stream. Two tests were conducted to combust (1) Sewickley coal (Pittsburgh, PA) and Tymochtee dolomite (Huntsville, OH) at bed temperatures ranging from 900 to 925°C and a system pressure of 9.2 atm absolute (Test Series No. 7) and (2) Beulah lignite (Beulah, ND) and Tymochtee dolomite at bed temperatures ranging from 850 to 875°C and a system pressure of 9.2 atm absolute (Test Series No. 8). 29 refs., 32 figs., 17 tabs.

39868 **Twenty-second symposium (international) on combustion.** 2072p. The Combustion Institute, Pittsburgh, Pennsylvania (1989). Sponsored by U.S. DOE Fossil Energy. DOE Contract FG01-88FE61626. From 22. international symposium on combustion; Seattle, WA (USA); 14-19 Aug 1988.

The following research areas were discussed at the symposium: coal combustion: carbon burnout, pyrolysis, furnaces, laboratory-scale combustion, and fluidized bed combustion; combustion-generated particulates: soot inception, growth, and soot formation in diffusion flames; engine combustion; turbulent combustion: flames in vortices, fractals and cellular automations, nonpremixed flames, premixed flames, premixed flame structure, and lifted flames; reaction kinetics: hydrocarbon oxidation, free radical chemistry, unsaturated species, aromatics, and nitrogen compounds/pollutant formation; combustion generated NO_x and SO_x; fires: flame spread, radiation, characterization, and unsteady flames; Laminar flames: structure, opposed-flow combustion, shape, propagation/extinction, and inhibition, oscillations, microgravity; ignition; detonations; dusts; propellants; diagnostics; combustion of drops, sprays, and dispersions, and slurries. Individual projects are processed separately for the data bases. (CBS)

39869 (CRIE–W-87034) **Review on advanced coal fired thermal power plant technology. Part 2. Recent development to improve operational characteristics.** Koyata, Kazuo; Ono, Tetsuo; Makino, Tadao; Tanaka, Takashi; Nagayama, Tsutomu. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Apr 1988. 59p. (In Japanese). Order Number DE89760385/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

The Technology improving middle load operation like lowering the minimum load was investigated to perform the advanced operation of fine coal fired thermal power plants. The advanced operation aims improvements of minimum load of present 35-50% to 20-30%, starting time of present 300-360 minutes to 120-150minutes, and load variation rate of present 0.5-3%/min to 2-5%/min. Improvement of mill operation and turndown mill are in the demonstration phase. The turndown mill has small ratio of continuous operatable minimum pulverizing capacity to maximum pulverizing capacity, making low load operation possible. The storage combustion system in which pulverized coal is temporarily stored and the direct ignition burner which utilizes ignitor so as to make the startup and stop possible without any combustion aiding oil. Low load stabilized combustion burner which concentrates supplied dilute pulverized coal flow(large carrying air volume/pulverized coal volume) is also promising. These techniques will be used practically after the demonstration tests. 27 references, 54 figures, 14 tables.

39870 (DOE/MC/23167–2678-Vol.1) **Advanced coal-fueled gas turbine systems, Volume 1: Annual technical progress report.** Westinghouse Electric Corp., Orlando, FL (USA). Power Systems Div. Jul 1988. 77p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23167. Order Number DE89000953/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This is the first annual technical progress report for The Advanced Coal-Fueled Gas Turbine Systems Program. Two semi-annual technical progress reports were previously issued. This program was initially by the Department of Energy as an R&D effort to establish the technology base for the commercial application of direct coal-fired gas turbines. The combustion system under consideration incorporates a modular three-stage slagging combustor concept. Fuel-rich conditions inhibit NO_x formation from fuel nitrogen in the first stage; coal ash and sulfur is subsequently removed from the combustion gases by an impact separator in the second stage. Final oxidation of the fuel-rich gases and dilution to achieve the desired turbine inlet conditions are accomplished in the third stage. 27 figs., 15 tabs.

39871 (DOE/MC/23248–2709) **Development of a new method for improving load turndown in fluidized bed combustors: Final report.** Brown, R.C. Iowa State Univ. of Science and Technology, Ames, IA (USA). Dec 1988. 90p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23248. Order Number DE89000994/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objective of this research was to investigate a new concept in fluidized bed design that improves load turndown capability. This improvement is accomplished by independently controlling heat transfer and combustion in the combustor. The design consists of two fluidized beds, one central and one annular. The central bed serves as the combustion bed. The annular bed is fluidized separately from the combustion bed and its level of fluidization determine the overall heat transfer rate from the combustion bed to the surrounding water jacket. Early theoretical considerations suggested a load turndown exceeding ten was possible for this design. This research consisted of three major phases: development of a computational model to predict heat transfer in the two-bed combustor, heat transfer measurements in hot-and-cold flow models of the combustor, and combustion tests in an optimally designed combustor. The computation model was useful in selecting the design of the combustor. Annular bed width and particle sizes were chosen with the aid of the model. The heat transfer tests were performed to determine if the existing correlations for fluidized bed heat transfer coefficients were sufficiently accurate for high aspect ratio fluidized beds (such as the annular bed in the combustor). Combustion tests were performed in an optimally designed combustor. Three fuel forms were used: double screened, crushed coal, coal-water-limestone mixtures (CWLM), and coal-limestone briquettes. 18 refs., 30 figs., 8 tabs.

39872 (DOE/PC/79915–T5) **Mechanisms of coal-water mixture combustion in fluidized beds: Technical progress report, March 14, 1988–June 15, 1989.** Brown, R.C. Iowa State Univ. of Science and Technology, Ames, IA (USA). 1989. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79915. Order Number DE89015854/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Research on combustion of coal-water mixtures continued. Results of previous quarters are discussed. This quarter, activation energies, and a comparison of residence times were explored. Calcination and sulfation tests planned for next quarter are briefly addressed. 8 refs., 1 fig., 2 tabs. (CBS)

39873 (DOE/PC/88910–T2) **Detoxification and generation of useful products from coal combustion wastes: Second quarterly technical report.** Arkansas Tech Univ., Russellville, AR (USA). [1989]. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88910. Order Number DE89015882/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have now received or collected all the necessary samples of flyash and bottom ash for completion of the project. Previously received flyash, desulfurization gypsum, and bottom ash from Ohio Edison have been augmented by flyash and bottom ash from the White Bluff Power Plant of Arkansas Power and Light and by samples of flyash obtained from the Tennessee Valley Authority. These samples will provide waste materials from high sulfur Eastern coal, low sulfur Western coal, and an intermediate mix, respectively. Progress is reported on the chemical analysis of the products. 6 figs.

39874 (ECN–89-087) **Transformations of pyrite in fine coal combustor. An exploratory model study on velocities and phase transformations.** Janssen, A.J.; Ten Brink, H.M. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1989. 39p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Netherlands Energy Research Foundation (ECN) carries out an experimental study on the title subject. The results of this study have been evaluated based on an American model which contains the most important elements of pyrite transformations. The model is developed by PSI Technology Company. The different phases of the model are discussed. A detailed description of the model is given in the appendix. The results of a practical example of transformations of inorganic coal constituents in combustion systems have been verified by and compared with the model. It is concluded that the model operates satisfactory. 12 figs., 2 refs., 5 tabs., 1 app.

39875 (EUR–11845, pp. 33-44) **Regenerative desulfurization in fluidized bed combustion of coal.** Bleek, C.M. van den (Delft University of Technology (Netherlands)); Berg, P.J. van den. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100, St., NW Suite 707 Washington, DC 20037.

New legislature will make regenerative desulfurization during FBC inevitable in the near future. The sulfur route in such a process is being studied now at Delft University of Technology. In the sulfur release step the mechanism of the combustion and decomposition of pyrite has been elucidated. A model is developed to describe the sulfur release pattern. To obtain an efficient sulfur capture a good particle mixing without segregation is necessary for an optimum contact between gaseous sulfur species released and sorbent material. A model is derived which sufficiently can describe the segregation of sorbent, coal and ash particles and can be used to calculate the conditions to avoid it. A regenerative sorbent is being developed. Its preparation is based on the sol-gel method, producing strong particles which show a low attrition rate, a sufficient sulfation behaviour and a promising regenerability at only 900 degrees C. Finally a simple SUlfur REtention (SURE) model was set up which can be used as a diagnostic tool for analysis of existing combustors as well as predictive tool for analysis of plants under construction or design, also at low oxygen concentration as met at substoichiometric firing conditions. All models presented do not contain any fit parameters; all parameters can be calculated from generally accepted literature data or can be easily measured or controlled. 32 refs., 13 figs., 3 tabs.

39876 (EUR–11845, pp. 45-56) **Development of a regenerative sulfur dioxide system.** Kamphuis, B. (University of Twente, Enschede (Netherlands)); Spitsbergen, U. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8806393–: CEC contractors' meeting on flue gas and fly ash, Brussels (Belgium), 16 Jun 1988). In *Flue gas and fly ash.* Available from European Community Information Service 2100 M St., NW, Suite 707 Washington, DC 20037.

Regenerative sulfur dioxide sorbents based on calcium oxide and on titanium oxide - to be applied during AFBC - were synthesized by agglomeration. This technique as well as the starting materials were selected considering technical and economic feasibilities. The sorbents were tested by TG methods and by measurements using a laboratory-scale AFB reactor. Calcium oxide based sorbents were prepared having both a mechanical stability equalling that of the hardest types of natural limestones, as tested, and a sulfur dioxide capacity sufficient to meet environmental standards. Residual calcium sulfide - though an unwanted product - contributes as an intermediate to the progress of regeneration reactions. Multicycle sulfation and regeneration tests showed an optimal regeneration behaviour below 1100 C while differences of sorbent quality faded with proceeding recycling. Titanium oxide based sorbents were prepared with which an absorption and regeneration cycle could be performed at a same temperature. The conversion was nearly complete but the sulfur dioxide transport per cycle small due to the low content of active material thusfar. The mechanical strength at high temperature of these sorbents, as tested, can be compared with that of the hardest natural limestones. 3 refs., 6 figs., 4 tabs.

39877 (EUR–11846) **Coal-water mixtures.** Sens, P.F.; Wilkinson, J.K. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). 1989. 104p. (CONF-8805314–: CEC contractors' meeting on coal-water mixtures, Brussels (Belgium), 26 May 1988).

Reports are presented of R & D work being carried out under the 'Utilization of Solid Fuels', performed under the supervision of the Directorate-General XII for Science, Research and Development of the Commission of the European Communities. 10 papers are presented in sections entitled: generic studies, CWM preparation, and CWM pulverization and combustion. All papers have been abstracted separately.

39878 (EUR–11846, pp. 66-71) **The utilization of CWM in the heavy clay industry.** Novara, G. (Morando Impianti, Asti (Italy)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

In the clayworking industry and in particular in the firing of clay new equipment is being proposed to utilize CWM as an alternative fuel to natural gas, LPG or heavy oil in tunnel kilns. The proposed equipment, which is now being designed, is basically a mixer of the CWM with primary air, this last acting in part as combustion air and in part as entrainment and atomizing fluid. Combustion of the mixture thus obtained takes place inside the kiln where the clay firing temperature (1000 degrees C average) is high enough to ensure ignition. The equipment is not restricted to the mixing pipe, but it comprises all that is required to feed the air and to pressurize the fuel. 3 figs.

39879 (EUR–11846, pp. 72-81) **Development of coal-water mixture firing in small commercial boiler applications.** Fynes, G. (British Coal Corporation, Stoke Orchard (United Kingdom). Coal Research Establishment); Peirce, T.J.; Welford, G. Commission of the European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures.* Available from European Community Information Service 2100 M St., NW Suite 707, Washington, DC 20037.

The work described relates to the application of coal-water mixture firing technology to the commercial (small premises) boiler sector (50 kW to 1 MW capacity range). An economic appraisal of the market potential for CWM firing in this sector has revealed that the market size is determined primarily by the price differential between coal and gas. For a price differential of 20 p therm^{-1}, the market for coal could be 4 MtcA if washery fines were used as the coal feedstock. For 10 p therm^{-1}, the potential market is minimal and, at 30p therm^{-1}, conventional stoker firing would compete with CWM firing. From a review of the design features of oil and gas-fired commercial boiler plant, the suitability of particular systems for CWM firing has been identified. A 1 MW combustor rig (in the form of a sectional shell boiler) has been commissioned for CWM firing trials. A novel form of CWM burner has been developed and shown to provide stable, unsupported CWM flames. Modifications to the burner were successfully made to minimise slag formation within the burner quarl. A second burner (of different design) is currently under construction. 1 ref., 5 tabs.

39880 (EUR–11846, pp. 82-90) **An experimental study at the scale of 200 kW, of atomization and combustion in a flash expansion burner.** Grouset, D. (Bertin et Cie, Plaisir (France)); Leonard, C.; Martin-Neuville, H.; Mulet, J.C. Commission of the

European Communities, Luxembourg (Luxembourg). 1989. (CONF-8805129–: European boundary element meeting, Brussels (Belgium), 8-10 May 1988). In *Coal-water mixtures*. Available from European Community Information Servie, 2100 M St., NW Suite 707, Washington, DC 20037.

Societe BERTIN are at present developing a 200 kW coal water mixture burner, where atomization of liquid fuel is achieved by flash expansion. In the future, this burner could be used in many industrial sectors (public works: asphalt production, food sector: dehydration and drying, metallurgy) or to burn liquid effluent with a low heat of combustion. The main advantages of CWM over pulverized coal are that there is no explosion risk during storage and that transportation through pipework can be made by a liquid pump. The work currently in progress and the main results obtained from work carried out are described: firstly, a rheological study of CWM is presented. It consists of an investigation into the effect of temperature upon the fluidity of different coal water mixtures. The knowledge of its rheological behaviour permitted the sizing of the heat exchanger. Secondly, the atomization test bench, including fluid supplies and measurement sensors are described. Lastly, atomization tests, successfully completed with water and CWM at various injection conditions (pressure, temperature) with use of different nozzle sizes are presented. The measurement of the droplet size was performed with a Malvern granulometer. The combustion test bench is actually in definition. 8 figs.

39881 (STEV–1988-R11) **PFBC-facilities. Status 1987.** Statens Energiverk, Stockholm (Sweden). 1988. 80p. (CONF-8610330–: IEA workshop on pressurized fluidized bed combustion, Stockholm (Sweden), 22-24 Oct 1986). Order Number DE89902385/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

An international workshop on PFBC was arranged in Stockholm 22 to 24 October 1986 under IEA auspices. The final report from that meeting has previously been published by the National Energy Administration. One of the items agreed upon was to produce a brochure on the present PFBC facilities in the world. Sweden undertook responsibility for compiling the information and for publishing it. The information contained in the brochure represents the situation during the first half of 1987, when most of the information was received. Additional operating hours have been obtained in several of the facilities since that time.

0150 Marketing and Economics

Refer also to citation(s) 40360, 40361

39882 (IEACR–16) **Prospects for Polish and Soviet coal exports.** Doyle, G. IEA Coal Research, London (UK). c Jun 1989. 70p. Available from IEA Coal Research, 14-15 Lower Grosvenor Place, London, SW1W 0EX, England.

This report investigates the reasons for the recently-declining volume of coal exports from Poland and the USSR. A survey of the two coal industries examines the historical coal production trends, the pattern of coal production, the structure of the industry, the coal types, the mining conditions, employment, labour productivity and costs. A discussion of coal production prospects, coal transport infrastructure, internal coal demand, and energy and trade policy leads the author to conclude that coal demand in Poland and the USSR will grow more rapidly than coal production. The implication of this is that coal exports will continue to decline. 54 refs., 9 figs., 60 tabs.

02 PETROLEUM

Refer also to citation(s) 40336

0201 Reserves

Refer also to citation(s) 40363

39883 (DOE/EIA–0294) **Field validation of the OGIS [Oil and Gas Information System] estimate of proved reserves of oil and gas in the United States as of December 31, 1977.** USDOE Energy Information Administration, Washington, DC (USA). Assistant Administrator for Energy Information Validation. Jun 1981. 378p. Sponsored by U.S. DOE Management & Administration. Order Number DE89015003/JAW. Available from NTIS, PC A17/MF A01 - GPO - OSTI; GPO Dep.

The Office of Energy Information Validation (OEIV) seeks in this report of its field validation activities to provide interested analysts as much relevant information as possible with which to understand the quality of data gathered about 1977 United States Crude Oil and Natural Gas Reserves by the Oil and Gas Information System (OGIS). Chapter I of this report summarizes necessary background information on petroleum reserves and production. It treats geological and institutional contexts. Chapter II of this report describes the relevant background on the OGIS content and collection effort. Chapter II emphasizes those portions of the OGIS effort which were closely tied to the OEIV studies, as reported in Chapter III. Chapter III describes what OEIV did for purposes of evaluation and displays the results. The basic report is supported by appendices that further extend documentation and treat certain technical issues in greater depth.

0202 Geology and Exploration

Refer also to citation(s) 39883, 39889

39884 (SAND–89-1504) **HSTRESS: A computer program to calculate the height of a hydraulic fracture in a multi-layered stress medium.** Warpinski, N.R. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 103p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC04-76DP00789. Order Number DE89013993/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

A computer code for calculating hydraulic fracture height and width in a stressed-layer medium has been modified for easy use on a personal computer. HSTRESS allows for up to 51 layers having different thicknesses, stresses and fracture toughnesses. The code can calculate fracture height versus pressure or pressure versus fracture height, depending on the design model in which the data will be used. At any pressure/height, a width profile is calculated and an equivalent width factor and flow resistance factor are determined. This program is written in FORTRAN. Graphics use PLOT88 software by Plotworks, Inc., but the graphics software must be obtained by the user because of licensing restrictions. A version without graphics can also be run. This code is available through the National Energy Software Center (NESC), operated by Argonne National Laboratory. 14 refs., 21 figs.

39885 A hardware/software system for implementing geophysical diffraction tomography. Witten, A.J. (Oak Ridge National Lab., Energy Div., Oak Ridge, TN (US)); King, W.C. vp. of Hybrid image and signal processing. Casasent, D.P.; Tescher, A.G. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8804194–: Hybrid image and signal processing, Orlando, FL (USA), 7-8 Apr 1988).

Geophysical diffraction tomography is a technique for high resolution, quantitative imaging of subsurface cross-sections. The method is based upon an imaging process known as filtered backpropagation which is a generalization of the inverse straight ray tracing process referred to as backprojection. In backprojection, an image of spatial variations in refractive index is formed by backpropagating data received along an array of detectors, by means of the reduced wave equation, from the array into the support volume of the host medium. Important steps in this imaging process include: (1) the synthesis of a coherent incident wave, (2) the determination of complex phase perturbations relative to a homogeneous background, and (3) the numerical application of a holographic lens. This paper describes a microprocessor-based data acquisition system specifically designed and fabricated for geophysical diffraction tomography, discusses signal processing algorithms which are implemented on the system and presents results of several field studies.

0203 Drilling and Production

Refer also to citation(s) 39883, 39906, 40126, 40129, 40361

39886 (DOE/MC/21136–21) **Improvement of CO_2 flood performance: Fourth annual report, October 1, 1987–September 30, 1988.** Heller, J.P.; Kovarik, F.S. New Mexico Inst. of Mining and Technology, Socorro, NM (USA). New Mexico Petroleum Recovery Research Center. Jul 1989. 344p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC21-84MC21136. Order Number DE89000756/JAW. Available from NTIS, PC A15/MF A01 - OSTI; GPO Dep.

In Task Area 1, an oscillating quartz viscometer was developed to measure viscosities of CO_2/hydrocarbon systems over a range of conditions. Viscosity dependency on density, composition, and temperature is examined and the functional form of a modified Lohrenz, Bray, and Clark correlation for CO_2-oil systems is presented. Also, the effect of free gas on displacement efficiency and that of multiple hydrocarbon phase flow on sweep efficiency are being investigated. With two-dimensional glass micromodels at reservoir conditions, we studied the effects of different scales of microscopic heterogeneity on flow behavior and blocking mechanisms using both in-situ foaming and pregenerated foam. Additionally, the initial formulation of a two-dimensional simulator which models high-pressure gas-foam flow is presented. A simulation of the processes of high-permeability zone blockage with foam, fluid diversion, and increased trapped oil recovery is included. Also, an NMR imaging study on fluid flow through porous media addressing the nonlinear stability analysis of miscible displacements and matrix-fracture fluid transport functions has been initiated. In Task Area 2, work commenced on the non-uniformity of flow which results from rock heterogeneity. Emphasis was placed on the effect of this non-uniformity on displacement efficiency. Measurements were made of the steady-state mobility of foam-like dispersions of dense CO_2 in surfactant solutions. 114 refs., 138 figs., 21 tabs.

39887 (UCRL–101566) **Analysis of a model and sequential numerical method for thermal reservoir simulation.** Trangenstein, J.A. Lawrence Livermore National Lab., CA (USA). 18 Jul 1989. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-890759–1: Joint IMA/SPE European conference on the mathematics of oil recovery, Cambridge (UK), 25-27 Jul 1989). Order Number DE89015117/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper we present and analyze a model for two-component, three-phase, nonisothermal fluid flow in a one-dimensional fluid reservoir. We discuss the thermodynamic principles that constrain the model functions, and analyze the effect of these thermodynamic principles on the flow equations. This analysis allows us to formulate a sequential approach to steam flooding: first a parabolic equation is solved to find the pressure and total fluid velocity, then a system of hyperbolic conservation laws is solved to update the fluid composition and energy. The thermodynamic principles allow us to compute the characteristic speeds and directions in the component/energy conservation equations, and to use these in a second-order Godunov method. 26 refs., 3 figs.

39888 An extended black oil miscible simulator that rigorously treats variable bubblepoint problems. Ammer, J.R. (U.S. DOE/METC (US)); Brummert, A.C.; Sams, W.N. pp. 397 of Proceedings of the SPE 1988 Eastern regional conference. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-8811167–: Society of Petroleum Engineers eastern regional conference, Charleston, WV (USA), 1-4 Nov 1988).

Technical Paper SPE 18533.

The extended, black-oil, miscible reservoir simulator MASTER was developed specifically to support the Department of Energy's Enhanced Oil Recovery Program. The implicit-in-pressure, explicit-in-saturation simulator contains mass balance equations for oil, water, natural gas, up to four solvent species, and a surfactant. Several options have been incorporated into MASTER to simulate the phenomena associated with gas miscible flooding: (1) including the loss of solvent to the aqueous phase, (2) choosing the degree that water blocks oil from contacting injected solvent, (3) allowing precipitation of asphaltenes with subsequent permeability reduction, and (4) reducing gas mobility as a function of surfactant concentration.

39889 Field measurements of dynamic pressure and seismic activity during foam fracturing. Locke, C.D. (BDM Corp. (US)); Overbey, W.K.; Yost, A.B. II. pp. 397 of Proceedings of the SPE 1988 Eastern regional conference. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-8811167–: Society of Petroleum Engineers eastern regional conference, Charleston, WV (USA), 1-4 Nov 1988).

Technical Paper SPE 18555.

Results of a highly-instrumented multiple-well field test to measure pressure responses during hydraulic stimulation of a naturally-fractured gas reservoir are presented. The field test consisted of a 70,000 gallon (265 m^3) foam frac in one of four test wells while monitoring bottomhole pressures in each of the four wells and monitoring the site with an array of tiltmeters. A 75-quality sand-laden foam was injected into the naturally fractured formation at a rate of 20 bbl/min (3.2 m^3/min). The injection rate was held nearly constant except for two brief interruptions. Sand concentration during the treatment ranged from zero to two and one-half pounds per gallon while average one pound per gallon.

39890 Inducing multiple hydraulic fractures from a horizontal wellbore. Overbey, W.K. (BDM Engineering Services Corp. (US)); Yost, A.B.; Wilkins, D.A. pp. 397 of Proceedings of the SPE 1988 Eastern regional conference. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-8811167–: Society of Petroleum Engineers eastern regional conference, Charleston, WV (USA), 1-4 Nov 1988).

Technical Paper SPE 18249.

A series of stimulations were designed to open and propagate natural fractures known to exist along a 2000 foot horizontal well in Wayne County, West Virginia. The stimulations were also designed to induce fractures in the formation as well as propagate the natural fractures by manipulating pressure and injection rates. A number of radioactive tracers were used to determine where fractures were opened and propagated at different injection rates. The tracers were found in fractures in zones other than the one pumped into, a fact considered prima facie evidence that natural fractures with two or more orientations had been opened and propagated.

0204 Processing

Refer also to citation(s) 40363

39891 (AOSTRA–8808, pp. 14) **Solid catalyzed thermal hydrogenolysis of residual oils.** Nakmura, I. (Univ. of Tokyo, Hongo Bunkyo-ku, Tokyo, Japan); Tominga, H.-O.; Fujimoto, D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton (Canada), 7-12 Aug 1988; CE–02593). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Several residual oils including Kuwait atmospheric residue and Athabasca oil-sand bitumen were cracked in the liquid phase under moderately pressurized hydrogen at around 440°C, in the presence of metal-supported active carbon or silica-alumina. While the non-catalyzed reaction proceeded smoothly, giving olefin-rich distillated, asphaltene-rich residual oils and fairly large amount of coke, the catalyzed reaction gave the same level of conversion, a substantial amount of coke (<10%) depending upon Conradson carbon residue, paraffin-rich distillate and asphaltene-free and metal-free residual oils with small hydrogen consumption. It is suggested that residual oil cracked thermally and the polycyclic moiety of asphaltene was adsorbed on the catalyst surface and dehydrogenated to coke. Hydrogen atoms generated during the coke formation spilt-over the catalyst surface to reach the metal site and hydrogenate free radicals and olefins. 9 refs., 11 figs., 2 tabs.

0205 Products and By-products

Refer also to citation(s) 39896

39892 Third international conference on stability and handling of liquid fuels: Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.). 398p. The Institute of Petroleum, London, United Kingdom (1988). Sponsored by U.S. DOE Fossil

Energy. DOE Contract FG01-88FE61634. From 3. international conference on stability and handling of liquid fuels; London (UK); 13-16 Sep 1988.

Papers presented at the Conference dealt with the storage and thermal stability of gasolines, jet fuels, diesel fuels, residual fuels and crude oils. Certain aspects of the handling of these materials were also considered, and a session was devoted to the problems of microbiological growth in liquid fuels. The largest group of papers was those associated with the stability of diesel fuels, closely followed by those dealing with jet fuels. In addition to the verbal presentations 7 posters were displayed throughout the Conference and are represented in these proceedings by full written papers. Individual projects are processed separately for the data bases.

39893 (DOE/EIA–0112(79)) **Energy data report: Sales of asphalt in 1979.** USDOE Energy Information Administration, Washington, DC (USA). 14 Oct 1980. 11p. Sponsored by U.S. DOE Management & Administration. Order Number DE89014983/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

The data presented in this publication were collected under mandatory authority pursuant to Section 13 (b) of the FEA Act of 1974, P.L. 93-275 on Form EIA-171, "Sales of Asphalt and Road Oils." The respondents to the survey represent a universe of asphalt producers and emulsion manufacturers. The figures in this publication are a simple aggregate of reported data. There were a total of 206 survey forms returned to the Energy Information Administration from 161 companies. Estimates for two non-respondents were based upon both their refinery production of asphalt and road oils for 1978 and 1979 and on their reported sales for 1978.

39894 (EPRI-GS–6459) **Fuel oil utilization 1988 workshop: Proceedings.** Sanders, C.F.; McDonald, B.L. Electric Power Research Inst., Palo Alto, CA (USA); Energy Systems Associates, Tustin, CA (USA). c Jul 1989. 288p. Sponsored by Electric Power Research Institute. (CONF-8811241–: Fuel oil utilization workshop, New Orleans, LA (USA), 16-17 Nov 1988). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This was the fifth workshop in a series dealing in part or whole with fuel oil utilization. The previous were held in 1983, 1985, 1986, and 1987. The primary objective of the 1988 session was the interchange and dissemination of information related to current fuel oil problems and projects conducted by several utilities, EPRI, EPRI contractors, and others. The Workshop consisted of presentations and free-flowing discussions of problems encountered in utility boiler systems burning residual oils as their primary fuel. Incorporated into the presentations were results of actual utility operating experiences, plant tests and demonstrations, and research studies. The presentation topics included, thermogravimetric analyses and viscosity characteristics in utility residual fuel oils, the effects of heavy fuel oils on power plant life expectancies, an economic evaluation of burning water-in-oil emulsions, an evaluation of compatibility/stability predictive tests, fuel oil tank mixing, a report on particle size and emissions of particulate matter from residual oil fired boilers, potential applications of a two-step carbon burnout model, pulse-jet fabric filters for particulate control with oil-fired boilers, and information on the prevention and control of spills of low API gravity fuel oils. Individual projects are processed separately for the data bases.

0207 Marketing and Economics

Refer also to citation(s) 40359, 40361, 40364

39895 (DOE/EIA–0380(89/04)) **Petroleum marketing monthly, April 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 20 Jul 1989. 213p. Sponsored by U.S. DOE Management & Administration. Order Number DE89015737/JAW. Available from NTIS, PC A10/MF A01 - GPO - OSTI; GPO Dep.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

0220 Transport, Pipelines, and Handling

Refer also to citation(s) 40363

0230 Properties

Refer also to citation(s) 39892, 39894, 40682

39896 **Third international conference on stability and handling of liquid fuels: Conference proceedings: Volume 2.** Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.). 456p. The Institute of Petroleum, London, United Kingdom (1988). Sponsored by U.S. DOE Fossil Energy. DOE Contract FG01-88FE61634. From 3. international conference on stability and handling of liquid fuels; London (UK); 13-16 Sep 1988.

Topics presented at the Conference dealt with the storage and thermal stability of gasoline, jet fuels, diesel fuels, residual fuels and crude oils. Certain aspects of the handling of these materials were also considered, and a session was devoted to the problems of microbiological growth in liquid fuels. The largest group of papers was those associated with the stability of diesel fuels, closely followed by those dealing with jet fuels. Examples are the oxygen overpressure technique for diesel fuel stability prediction and the fiber optic JFTOT modification. In addition to the verbal presentations 7 posters were displayed throughout the Conference and are represented in these proceedings by full written papers. Individual projects are processed separately for the data bases.

39897 **Radiative heating of a conventional and aromatic turbine fuel.** Richards, G.A. (Morgantown Energy Technology Center, WV (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(4): 891-897 (1988). (CONF-8809272–: Coal combustion and soot formation, Los Angeles, CA (USA), 25-30 Sep 1988).

A simple procedure has been described to calculate a droplet absorption coefficient for infrared radiation. The coefficient can be calculated with reasonable accuracy from spectral absorption data on fuel samples. The coefficient was calculated for the fuels JP-4 and toluene. Results were relatively insensitive to fuel type but very dependent on the drop size. As expected, the results demonstrate that convection is more important than radiation in heating the drop. However, the present calculations are necessary to evaluate the radiative heating in situations where no convection operates, i.e., the propagating flame. This situation will be described in a subsequent paper.

0240 Storage

Refer also to citation(s) 39892, 39896

0250 Combustion

Refer also to citation(s) 39897

03 NATURAL GAS

0301 Reserves

Refer also to citation(s) 39883

39898 (ERCB–GB89-5) **Gas reservoir review 89-1.** Energy Resources Conservation Board, Calgary, AB (Canada). 1989. 7p. Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, Canada T2P 3G4; $N/C.

The Alberta Energy Resources Conservation Board has scheduled a reservoir review for several gas pools and requests industry submissions respecting them. Three different geological trends, each encompassing a number of pools, have been selected for

review as have a number of other individual pools. The Board believes that it is beneficial to review all pools in a geological trend simultaneously, which can be accomplished by focusing the study on a cross-section of representative component pools and then extrapolating the results from these pools to the entire trend. The Board emphasizes that it is interested in receiving all detailed supporting information that is relevant, particularly applicable pool performance analyses. This bulletin lists the pools to be reviewed and includes data on current reserves. Review submission procedure is also outlined. 2 tabs.

0302 Geology and Exploration

Refer also to citation(s) 39883, 39885, 39900

0303 Drilling, Production, and Processing

Refer also to citation(s) 39883, 39889, 39906

0304 Products and By-products

39899 (CONF-8810273–, pp. 3, Paper 5) **Present situation and problem of introduction of LNG in Japan.** Akiyama, Y. (Tokyo Gas Co., Ltd. (Japan)). Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

The author first summarizes the energy supply/demand situation in Japan, which showed consumption growing by 4.8% in 1987 over the previous year. He then briefly describes the history of LNG in Japan, which began in 1969 primarily for large-scale thermal power generation and backup source for urban gas supplies. Also, LNG introduction into Japan was accelerated in the oil crises of 1973 and 1979 to help overcome the fragile energy-supply structure. Presently he sees the LNG market situation in Japan changing since (1) demand for power base load has almost reached the limit, and (2) more competition in energy fuels in the industrial sector.

0306 Marketing and Economics

Refer also to citation(s) 40329

0309 Artificial Stimulation

Refer also to citation(s) 39889

39900 The evaluation and optimization of hydraulic fracturing treatments for the big injun formation in West Virginia. Aminian, K. (West Virginia Univ., WV (US)); Ameri, S.; Bright, D.; Yost, A.B. pp. 397 of Proceedings of the SPE 1988 Eastern regional conference. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-8811167–: Society of Petroleum Engineers eastern regional conference, Charleston, WV (USA), 1-4 Nov 1988).

Technical Paper SPE 18540.

The stimulation and production data from a number of Big Injun wells in West Virginia have been collected and analyzed in order to develop the optimum design guidelines for successful applications. The production data were analyzed with the aid of production decline type curve to establish basic reservoir parameters. A commercial simulator and stimulation data were then utilized to match the production history in order to evaluate the formation characteristics. The results of history matching were then utilized to optimize the treatments on each well. Cost analyses were subsequently performed to select the most economic treatment. The results of this preliminary study indicated that the optimum treatment designs based on the reservoir parameters can further improve the economic production.

0310 Legislation and Regulation

Refer also to citation(s) 39898, 40329

0320 Transport, Pipelines, and Handling

Refer also to citation(s) 41381

39901 (CONF-8905186–1) **Changes in soil properties and crop production due to pipeline construction.** Zellmer, S.D.; Taylor, J.D.; Johnson, D.O. Argonne National Lab., IL (USA). 1989. 18p. DOE Contract W-31109-ENG-38. From Pipeline session; New Orleans, LA (USA); 21-24 May 1989. Order Number DE89015160/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Trenching and backfilling during pipeline construction disturb the soil, causing temporary or permanent changes in edaphic conditions that may influence plant growth and crop yields. Three edaphic and crop production studies are a part of the Right-of-Way Research Program being conducted by Argonne National Laboratory for the Gas Research Institute. Study sites are located in Beaver County, Oklahoma; Kankakee and Iroquois Counties, Illinois; and Midland County, Michigan. Soil profiles from the pipe ditch, working side, and an adjacent undisturbed area are sampled, analyzed, and compared, using accepted methods. Wheat and grain sorghum yields were also measured at the Beaver County site. Results indicate that (1) pipe-ditch soils can differ significantly from adjacent undisturbed soil in bulk density, particle-size distribution, and available moisture capacity and (2) organic matter and plant nutrients are redistributed in the new pipe-ditch soil. Properties of the new pipe-ditch soil reflect the concentrations and relative volumes of the soil horizons in the adjacent undisturbed soil. These altered edaphic conditions have not caused a decline in soil productivity or crop yields. Data from these studies provide a better understanding of the changes that can occur in pipe-ditch soils because of pipeline construction and can be used in responding to concerns of regulatory agencies and ROW owners. 23 refs., 2 figs., 4 tabs.

39902 (SV-UG–1988-42) **Risks of accidents by natural gas distribution.** Swedish State Power Board, Vaellingby (Sweden). 26 May 1987. 31p. (In Swedish). Order Number DE89902436/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Application of natural gas is one of the safest energy supply systems existing considering the whole chain from gas well to consument. The risk of a serious near-accident in the Swedish transmission system will be once in a thousand years. The cause of most near-accidents in the pipe system is external damage from excavations or the like. The greatest risk of near-accidents by natural gas applications is by the consumers and in the devices for burning the gas. In this field continued risk studies would provide a clearer picture of causes and consequences of near-accidents.

39903 (SV-UG–1989-2) **Glassfibre reinforced plastics for natural gas distribution.** Svensson, B. Swedish State Power Board, Vaellingby (Sweden). 12 Dec 1988. 115p. (In Swedish). Order Number DE89902440/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

In Sweden the purpose is to use the GRP-pipes for system-pressure up to 80 bar, and with safetyzones less than 25 meter, which is the requirement for steel pipes at pressure levels above 16 bar. This would enable the supply of highpressure natural gas to, for instance, gas turbine plants inside cities. The motive for reduced safetyzones would be that even after a fracture of the pipe wall there always remains an intact glassfibre 'web', and thus the GRP-pipe being less sensitive to external damage. An economic evaluation of the total pipeline construction cost is made. The GRP-pipe is economically attractive, provided that it may be used for pressures up to 80 bar where 16 bar is the maximum pressure for steel pipes. Basically the position that lab and field tests are required to verify that GRP is a material suited for use in this application. A draft for test specifications is included in this report. An estimation is made of the maximum market potential for GRP-pipes in the planned Mid-Swedish natural gas network. For the continuation of the project it has been decided to carry out the required tests during 1989-1990. Also included in this report is some documentation of a separate activity within the project: The production of pressure vessels intended for use on natural gas fueled city-buses.

0340 Combustion

Refer also to citation(s) 40424

39904 (CRIE–T-88003) **Full scale catalytic combustion of methane under atmospheric pressure.** Fukuzawa, Hisashi; Mandai, Shigehiro. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 36p. (In Japanese). Order Number DE89772354/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

Recently, research and development of catalytic combustion has been conducted for NOx control in LNG combined cycle power plant. This paper describes the design and manufacture of a full scale catalytic combustor for 1300^{0}C, 100 MW gas turbine, the performance in methane combustion test under atmospheric pressure and the availability of the catalytic combustor. The designed and manufactured catalytic combustor consists of a reverse annular preburner, a annular premixer and palladium catalyst. The dimensions of combustor is diameter 450*800 mm (catalyst diameter 302mm). The combuster showed approximately excellent performance in the test, and it is considered that the combustor is able to apply to gas turbine systems. The excellent performance is expected at the operating conditions of gas turbine as follows; combustion efficiency of 99.8% and above, and NOx emission of about 10 ppm. 3 references, 2 figures, 2 tables.

04 OIL SHALES AND TAR SANDS

0402 Site Geology and Hydrology

Refer also to citation(s) 39906

39905 (AOSTRA–8808, pp. 18) **The Provost Upper Mannville B Pool. An integrated reservoir analysis.** Kramers, J.W. (Alberta Research Council, Edmonton, AB, Canada); Bachu, S.; Cuthiell, D.; Lytviak, A.T.; Hasiuk, J.E.; Olic, J.J.; Prentice, M.E.; Yuan, L.P. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton (Canada), 7-12 Aug 1988; CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

The Provost Upper Mannville B Pool is contained in McLaren Formation sands of Upper Mannville (Lower Cretaceous) age in the heavy oil belt of east central Alberta. Original oil in place has been estimated at approximately 34,200,000 m^3 13^0 American Petroleum Institute oil. The reservoir is up to 35 m thick and contains local areas of underlying water, a water to oil transition zone, and isolated patches of overlying gas. Wells in the reservoir have primary production and three EOR projects are or have been active in the pool. The reservoir sands were deposited in fluvial environments filling a McLaren valley that was aggraded during a sea level rise. The sands are mineralogically mature and are composed predominantly of quartz. A heterogeneity in the reservoir is the presence of zones of shale breccia or shale clasts in a sand matrix. These shale clasts constitute as much as 85% by volume in some zones and can represent a significant vertical barrier to fluid flow. In order to simulate the impact of the shale clasts on recovery processes, parameters such as vertical and horizontal permeability have to be estimated for these zones. To arrive at realistic values, small-scale finite-element models, based on actual clast distributions from cores, have been constructed and equivalent values for vertical and horizontal permeability have been obtained at the core scale. The reservoir pore systems have been characterized using petrographic image analysis techniques on actual pore images obtained from thin sections. The results have been correlated with the geological facies to ascertain whether pore systems within facies are consistent and pore systems between facies are different. 29 refs., 15 figs.

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 39891

39906 Devonian Shale oil production analysis and evaluation. Watts, R.J. (U.S. DOE/METC (US)); Yost, A.B. II; Ferrell, H.H.; Kennedy, J.; Lowry, P. pp. 397 of Proceedings of the SPE 1988 Eastern regional conference. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-8811167–: Society of Petroleum Engineers eastern regional conference, Charleston, WV (USA), 1-4 Nov 1988).

Technical Paper SPE 18552.

An analysis and evaluation of the Devonian Shale oil production's rapid decline rates and future potential were performed. Various analysis techniques were employed to evaluate the performance of oil wells completed in the Lower Huron Member of the Devonian Shale in a seven-county area of western West Virginia and southeast Ohio. The analyses included material balance, and analysis of production data by a transient method and numerical simulation, together with statistical methods. Results of the evaluation showed that the coexistence of natural fractures and matrix permeability and porosity are necessary for oil production from the Lower Huron in this area. Matrix permeability and porosity created by the inclusion of silt in the shales are necessary for oil accumulation and production.

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 40054, 40578

39907 (ANL/ES–161) **MILDOS-AREA: An enhanced version of MILDOS for large-area sources.** Yuan, Y.C.; Wang, J.H.C.; Zielen, A. Argonne National Lab., IL (USA). Jun 1989. 131p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. Order Number DE89014334/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The MILDOS-AREA computer code is a modified version of the MILDOS code, which estimates the radiological impacts of airborne emissions from uranium mining and milling facilities or any other large-area source involving emissions of radioisotopes of the uranium-238 series. MILDOS-AREA is designed for execution on personal computers. The modifications incorporated in the MILDOS-AREA code provide enhanced capabilities for calculating doses from large-area sources and update dosimetry calculations. The major revision from the original MILDOS code is the treatment of atmospheric dispersion from area sources: MILDOS-AREA substitutes a finite element integration approach for the virtual-point method (the algorithm used in the original MILDOS code) when specified by the user. Other revisions include the option of using Martin-Tickvart dispersion coefficients in place of Briggs coefficients for a given source, consideration of plume reflection, and updated internal dosimetry calculations based on the most recent recommendations of the International Commission on Radiation Protection and the age-specific dose calculation methodology developed by Oak Ridge National Laboratory. This report also discusses changes in computer code structure incorporated into MILDOS-AREA, summarizes data input requirements, and provides instructions for installing and using the program on personal computers. 15 refs., 9 figs., 26 tabs.

0504 Feed Processing

Refer also to citation(s) 40000, 40028, 40068, 40072, 40074, 40576

39908 Technical, political and institutional challenges associated with the Uranium Mill Tailings Remedial Action Project. Arthur, W.J. (Uranium Mill Tailings Remedial Action Project, U.S. Dept. of Energy, Albuquerque, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Uranium Mill Tailings Remedial Action (UMTRA) Project was created in 1978 with passage of the Uranium Mill Tailings Radiation Control Act (Public Law 95-604), which required cleanup of twenty-four inactive uranium processing sites and an estimated 5,000 vicinity properties containing residual radioactive materials from the

processing sites. Remedial action planning and implementation have been carried out in a complex interrelationship of technical, political and institutional issues. It is the objective of this presentation to provide a summary of the types of issues confronting the remedial action program, and the various ways the Department of Energy (DOE) and its contractors have closely worked with the numerous federal, state and Indian tribal agencies and the public to successfully implement the remedial action program.

39909 **Uranium Mill Tailings Remedial Action Project Vicinity Property Program.** Little, L.E. (U.S. Dept. of Energy, Grand Junction, CO (US)); Potter, R.F.; Arpke, P.W. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Department of Energy Uranium Mill Tailings Remedial Action (UMTRA) Grand Junction Project Vicinity Property Program is a $165 million program for the removal and disposal of uranium mill tailings that were used in the construction of approximately 4,000 residences, commercial buildings, and institutional facilities in the City of Grand Junction and surrounding Mesa County, Colorado. This paper discusses the UMTRA Vicinity Property Program and the economic benefits of this program for the City of Grand Junction and Mesa County, Colorado. The Bureau of Reclamation Economic Assessment Model (BREAM) was used to estimate the increases in employment and increases in personal income in Mesa County that result from the Vicinity Property Program. The effects of program-related changes in income and taxable expenditures on local and state tax revenue are also presented.

39910 **Liability protection for transportation of nuclear waste.** Kuznick, S.K. (Office of the General Counsel, U.S. Dept. of Energy, Washington, DC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Liability protection for the transportation of nuclear waste has been provided since 1957 through the PriceAnderson Act. Although authority to enter into new indemnity agreements under the Act expired on August 1, 1987, most nuclear waste shipments remain covered by the PriceAnderson system. The House of Representatives has passed a new bill that would renew the Act and significantly increase the amount of money immediately available to pay claims arising out of a nuclear accident. The U.S. Department of Energy supports Senate passage of the House bill because it provides a complete system of financial protection for both the public and the contractors.

39911 **Planning at selected UMTRA Project sites.** Dery, V.A. (Jacobs Engineering Group Inc., Albuquerque, NM (US)); Matthews, M. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Uranium Mill Tailings Remedial Action (UMTRA) Project involves remedial work at 24 mill processing sites in ten states. To date remedial work is complete at two sites, in progress at five others, and the planning for the remaining sites is well advanced. Previous papers have described the construction work and remedial action design at some of these sites. This paper documents the status of the planning of the remedial action work at four of the lower priority sites; namely, Spook, in Wyoming, Belfield and Bowman, in North Dakota, and Falls City, in Texas. While these sites are of relatively priority in the UMTRA Project, the engineering work required to bring the sites to a level where they comply with the U.S. Environmental Protection Agency (EPA) standards involves many interesting and unique approaches. This paper describes the different engineering plans and approaches being adopted for remedial work at the sites listed.

0507 Fuels Production and Properties

Refer also to citation(s) 40076, 40081, 40221, 40223, 40240, 40499, 40878, 40919, 41223

39912 (HEDL-SA–3690) **Powder handling for automated fuel processing.** Frederickson, J.R.; Eschenbaum, R.C.; Goldmann, L.H. Hanford Engineering Development Lab., Richland, WA (USA). 9 Apr 1989. 14p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76FF02170. (CONF-8904248–1: American Ceramic Society conference, Pittsburgh, PA (USA), 26-30 Apr 1989). Order Number DE89014944/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Installation of the Secure Automated Fabrication (SAF) line has been completed. It is located in the Fuel Cycle Plant (FCP) at the Department of Energy's (DOE) Hanford site near Richland, Washington. The SAF line was designed to fabricate advanced reactor fuel pellets and assemble fuel pins by automated, remote operation. This paper describes powder handling equipment and techniques utilized for automated powder processing and powder conditioning systems in this line. 9 figs.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 39928, 39982, 40481, 40611, 40612, 40663, 40678

39913 (CEA-R–5478) **Redox reactions of neptunium in tributyl phosphate-dodecane mixtures.** Wehrey, F. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Strasbourg-1 Univ., 67 (France). 1989. 144p. (In French). Order Number DE89903267/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

In relation with the reprocessing of irradiated fuels, disproportionation and oxidation by nitric acid of pentavalent neptunium in tributyl phosphate-dodecane mixtures have been studied. The experimental part of this work is based on spectrophotometric measurements. The disproportionation of pentavalent neptunium in organic perchloric medium is a second order reaction with respect to neptunium V. The reaction rate is strongly influenced by the perchloric acid concentration and has a higher value than in an aqueous medium. The reverse reaction in nitric media is a first order with respect to tetravalent and hexavalent ions. The reaction rate is a function of the reverse of the square of the nitric acid concentration. The energy of activation is the same than in aqueous medium. The oxidation rate of pentavalent neptunium by nitric acid is increased by nitrous acid. When no nitrous acid is added to the mixture, the reaction revealed to be autocatalytic, possesses an induction period. When nitrous and nitric acids are in excess to neptunium the reaction is first order with respect to neptunium. The reaction rate depends on the concentration of nitric acid and is a linear function of the concentration of nitrous acid. In tributyl phosphate dodecane mixtures the reaction occurs spontaneously. It is not the case in aqueous media. The values of thermodynamical and kinetical constants determined in this work could be used in a modelization of the behavior of neptunium in the reprocessing of irradiated fuels, which has to eliminate this element among its tasks.

39914 (FRNC-TH–3443-1) **Trapping of iodine in spent fuel reprocessing plants.** Hamon, D. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France). 1988. 160p. (In French). Order Number DE89903251/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The study shows the interest of using catalyst supports impregnated with silver nitrate instead of zeolites exchanged with silver. AC.1620 which is an amorphous silica impregnated with silver nitrate (12 wt % of Ag) is especially studied. This material is experimented for qualification in next French reprocessing plants. Main characteristics are determined (grain size distribution, porosity, density pore diameter, specific area, Ag distribution). A simple method is developed for silver content determination. Influence of various parameters on methyl iodide decontamination factor is examined: temperature, material size, NO content in the gas, ratio NO_2/NO, aging, iodine content and gas velocity. Trapping by physisorption and isotopic exchange on the iodine saturated product is evidenced. Regeneration of the N0 degraded material is investigated.

39915 (FRNC-TH-3443-2) **Trapping of iodine in spent fuel reprocessing plants.** Hamon, D. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France). 1988. 118p. (In French). Order Number DE89903250/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Main processes for trapping radioactive iodine on solids or liquids in fuel reprocessing plants are reviewed. For each process chemical reaction mechanisms are described, influence of main parameters on trapping performance is examined (temperature, relative humidity, iodine content, etc), advantages and disadvantages are indicated. 63 refs.

39916 (PtUB–21) **PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.** Diefenbacher, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. 410p. (In German). (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). Available from Copy held by UB/TIB Hannover.

The present reports represent the state and development of the R+D projects on nuclear fuel cycles sponsored by the Federal Government. A large number of these projects have as their aim the construction and operation of the large reprocessing plant of the FRG in Wackersdorf and of the final storage site at Gorleben; that is to say, the projects are concerned with issues of nuclear waste disposal in the field of reprocessing and with the storage of nuclear fuels and radioactive waste. The priorities here include safety research with regard to nuclear fuel cycles and safety analyses for final storage, as well as the recycling of residual substances. (RB).

39917 (PtUB–21, pp. 23-43) **Passivity and corrosion of special metals.** Schultze, J.W. (Duesseldorf Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie und Elektrochemie); Elfenthal, L.; Hochfeld, A.; Lindemeier, F.; Meisterjahn, P.; Meyer, A.; Siemensmeyer, B.; Wolff, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5594. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

This project was concerned with the passivation of special metals and with the investigation of the stability of the passive layers and their possible decomposition reactions. The metals zirconium and tantalum were in the centre of interest. For the test, the three possible fields of application of the materials were simulated in the currentless state or under anodic and cathodic load. Furthermore, the influence of radiation on the stability of the passive layers (e.g. by simulation experiments with titanium as cathode material) was investigated. (orig./RB).

39918 (PtUB–21, pp. 45-56) **Results concerning plutonium chemistry in the nitrato system and the solubility of plutonium dioxide in nitric acid.** Steinhauser, M. (Muenchen Univ. (Germany, F.R.). Radiochemische Abt.); Hoffmann, G.; Boehm, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5635. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

In order to be able to further increase the solubility of PuO_2 in nitric acid, experiments on solubility were carried out in an autoclave at an increased temperature (230°C). The degree of dissolution is strongly influenced by the quantity of the plutonium already dissolved, as can be seen from the addition of Pu^{4+} or PuO_2^{2+} ions at the beginning of the test. This knowledge led to the application of a pressure-extraction dissolution method with the plutonium, just dissolved, being removed continuously from the solvent acid and concentrated in the acid pool in the bottom part of the autoclave. By oxidation and evaporation of this solution, plutonyl nitrate hydrates are obtained which - due to their radiologically induced autoreduction to Pu^{IV} - are not very stable. (RB).

39919 (PtUB–21, pp. 81-106) **Experimental system for demonstrating passive cooling of HAW interim storage facilities. Summarizing report covering the project period 1983 up to 1987.** Voelkl, H. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl A fuer Thermodynamik); Sandner, H.; Mayinger, F. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5392. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

At the planned reprocessing plant in Wackersdorf, the secondary cooling of highly radioactive waste (nitric acid solutions) is to be carried out with the help of a passive cooling system having three coupled thermosiphon cycles, a cooling system which is always ready for operation, regardless of the active plant cooling system, and which operates safely even at very low outside temperatures. The structure and functioning of the cooling system developed for this purpose are described. The dynamic behaviour of the coupled cycles was tested in an experimental plant. An equation system was set up for the description of the non-stationary behaviour of the coupled system, and a computer programme was developed to solve the equation. (RB).

39920 (PtUB–21, pp. 107-111) **Novel instruments solving measuring problems in connection with the PUREX process.** Hampel, G. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)); Gerlach-Meyer, U.; Gidarakos, E.; Froehlich, H.; Mitlehner, J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5786. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

This study briefly summarizes and evaluates the state of the art of measuring methods, either already applied or under development, which can be used in the PUREX process. In addition, recommendations for the further development of instruments are given. (orig./RB).

39921 (PtUB–21, pp. 131-156) **Effects of admixtures on the ignition of Zircaloy.** Praetorius, R. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernchemie); Muenzel, H.; Braun, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5776. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on*

subjects of the nuclear fuel cycle. Available from Copy held by UB/TIB Hannover.

The fire behaviour of the fine components of Zircaloy such as those which emerge during the chopping of fuel cans at the head-end of the reprocessing was studied in terms of its dependence on admixtures - KOH, KCl, HCl, HNO_3, O_2, Sb_2O_3 i.a., as liquids or dusts -. Ignition temperature and the rate of fire spread were measured. Two different fire types distinguishable by a considerable difference in temperature - >3000^{0}C as compared to about 1000^{0}C - were discovered during the measurements. The oxygen-producing companion substances promote the high-temperature process; very high rates of fire spread were noted specifically with HNO_3. (RB).

39922 (PtUB–21, pp. 157-169) **Characterisation of precipitation samples of MOX fuel solutions.** Henkelmann, R. (Technische Univ. Muenchen, Garching (Germany, F.R.). Inst. fuer Radiochemie); Baumgaertner, F.; Klein, F.; Niestroj, B. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5877. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

Despite the fine clarification of the fuel feeding solution for the Purex process, disturbances occur in the form of high-activity precipitations as a result of the feed sewage sludge. Subsequent precipitation samples of dissolved OKOM and AuPuC-type MOX fuel rods were studied with regard to microstructure as well as to nuclide and chemical composition, under conditions of burn-up and subsequent precipitation time. Alpha and gamma spectroscopy, REM data and EDX spectroscopy were applied. (RB).

39923 (PtUB–21, pp. 171-182) **The light platinum metals in the feed sewage sludge of FBR - their anodic dissolution and subsequent separation and extraction.** Geckeis, H. (Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Fachrichtung Anorganische Analytik und Radiochemie); Ahmadian, N.; Blasius, E.; Neumann, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5796. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

To produce the economically useful elements rhodium and palladium from the feed sewage sludge of fuel reprocessing, it is necessary to separate the volatile elements technetium and ruthenium, which constitute disturbance factors during subsequent vitrification. Here, simulated alloys of feed sewage sludge were dissolved in an electrolytic solvent (Ru can be removed by distillation from the receiver); the solution in the TBF/HNO_3 extraction system was then studied with consideration to the concentration of TBP or HNO_3 and to their suitability for the separation of Tc, Rh and Pd. Tc and Pd can be extracted sequentially, if the parameters selected are appropriate. This system is not suitable, however, for the separation of Rh. (RB).

39924 (PtUB–21, pp. 183-199) **Study of entrainment effects with U, Cr, Fe, and Nd in systems of relevance to the PUREX process.** Kriegel-Gumprecht, S. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Anorganische und Analytische Chemie); Gauglitz, R.; Frydrych, C.; Gallasch, D.; Wessel, M.L.; Marx, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5847. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The analytical ultracentrifuge was employed for the determination of the diffusion coefficients of U, Np and Nd (as fission products), and of Cr and Fe (as corrosion products); nitric acid was used in a practice-relevant concentration. The concentration gradients of the dissolved substance in the solvent were measured at different times with the help of UV/VIS spectroscopy; at the same time the transfer of all the agitated particles was observed by means of schlieren optics. An increase of the diffusion of nitric acid by an additional gradient of the element concentration can be observed in all the elements studied. Moreover, there was the indication that the transfer of the applied elements chromium, neodymium, uranium and iron were not affected by an additional nitric acid gradient. Only neptunium appears to behave differently. (orig./RB).

39925 (PtUB–21, pp. 281-292) **Separation of droplets from liquids by means of fibre bed separators and study of an electrostatic mist precipitator.** Rebelein, F. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl A fuer Verfahrenstechnik); Blass, E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5887. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The construction and functioning of fibre bed separators and electrostatic mist eliminators are described. While the latter are still in the testing stage, extensive studies have already been carried out with fibre bed separators and with the material systems TBP/n alkane in H_2O or 3 m HNO_3, as well as H_2O or 3 m HNO_3 in TBP/n alkane; the volume of droplets remaining after the elimination process was determined. The parameters droplet diameter, fibre bed load, fibrous material and fibre thickness, dispersion and depth of fibre bed were altered. (RB).

0509 Transport and Storage

Refer also to citation(s) 39919, 39964, 39999, 40071, 40073

39926 (CEA-DAS–563) **Transport of radioactive material by air, proposal for a revision of the regulation.** Devillers, C.; Ringot, C. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Jan 1989. 10p. (CONF-881299–: IAEA Technical Committee, Vienne (Austria), 5-9 Dec 1988). Order Number DE89903264/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The regulation should be modified in such a way that the packages used for the air transport of radioactive material presenting a high level of potential danger be designed to fulfill their safety functions for a large fraction of the conditions likely to be encountered in an aircraft accident.

39927 (KFK–4549) **Coincidence and pulsed neutron assay of sealed α-waste drums.** Wuerz, H.; Eyrich, W.; Klotz, W.D. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Mar 1989. 99p. Order Number DE89795007/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report describes the methods, the measurement systems, the correction procedures and the results. Generally the results of the coincidence method are in better agreement with the actual values. However the Pu values are systematically overestimated. This demonstrates that the correction procedures have to be improved

and that methods for matrix identification are of great importance. For the pulsed neutron method the influence of sample self-shielding was demonstrated. It turned out that the correction procedure for the influence of matrix composition as used for the data evaluation is inadequate for neutron absorbers. This becomes important if just instead of hydrogeneous matrix materials such as PE foam real waste materials with a high PVC content are used. The measurements were done in the frame of a Round Robin Test Exercise on α-contaminated waste sponsored by the European Community (EC). The aim of the Exercise was a comparison of methods and equipment available in different laboratories in the EC for the nondestructive assay of α-waste drums. (orig./HP).

39928 (LA-UR–89-2241) **Unattended system for monitoring skip movement at the Sellafield Facility in the United Kingdom.** Bosler, G.E.; Klosterbuer, S.F.; Johnson, C.S.; Hale, W.R.; Marsh, R.D.; Dickinson, R.J. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–52: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015243/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An unattended system for monitoring spent-fuel movement in the storage area of a reprocessing facility has been developed and tested. The system uses radiation detectors to determine when fuel is being moved and a video system to record images of the container movement. In addition to the recorded image, other recorded data include the date and time of the movement and "fingerprint" information from the radiation detectors. The direction of motion either into or out of the storage pond is indicated on the video image and on the printed readout. This system was extensively tested at the Sellafield Facility in the United Kingdom. This paper gives the details of the system design and presents results of the field evaluation. 1 ref., 10 figs.

39929 **Hydrogen loss and recombination in an unvented TRUPACT-I.** Smith, C.F. (Science Applications International Corp., Pleasanton, CA (US)); Borger, W.F.; Nielsen, T.H.; McKinley, K.; Morton, L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The loss of hydrogen from an unvented TRUPACT-I shipping container, and the feasibility of hydrogen control through the incorporation of catalytic recombiners were experimentally evaluated in two series of tests conducted at Science Applications International Corporation laboratory facilities in Sunnyvale, California.

39930 **TMI-2 rail cask and railcar maintenance.** Tyacke, M.J. (EG and G Idaho, Inc., Idaho Falls, ID (US)); Ayers, A.L. Jr.; Ball, L.J. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper describes the NuPac 125-B cask system (i.e., cask and railcar), and the maintenance and inspection requirements for that system. The paper discusses the operations being done to satisfy those requirements and how, in some cases, it has been efficient for the operations to be more rigorous than the requirements. Finally, this paper discusses the experiences gained from those operations and how specific hardware and procedural enhancements have resulted in a reliable and continuous shipping campaign.

39931 **Development of circumferential honeycomb impact limiters for a Defense High Level Waste shipping cask.** Zimmer, A. (GA Technologies Inc., San Diego, CA (US)); Koploy, M.A.; Rickard, N.D.; Madsen, M.M.; Uncapher, W.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Circumferential honeycomb impact limiters provide lightweight, low-volume impact protection for nuclear waste shipping casks with circular cross sections. GA Technologies (GA) has developed an empirical procedure for designing circumferential honeycomb impact limiters to limit the impact g-level to a predetermined level. Sandia National Laboratories (SNL) has performed a series of tests demonstrating that the circumferential honeycomb impact limiters are effective and can be adequately designed using this empirical procedure. Circumferential honeycomb impact limiters are currently used on the Defense High Level Waste (DHLW) truck shipping cask and are planned for use on several new casks which are scheduled for development during the next few years. This paper describes the structural design of the circumferential honeycomb impact limiters, presents the empirical design procedure for predicting the impact g-level and required volume of honeycomb, and compares test results with predicted results.

39932 **Tracking radioactive shipments using radio-navigation and satellite telecommunication systems.** Harmon, L.H. (United States Dept. of Energy, Germantown, MD (US)); Habib, E.J.; Hurley, J.D.; Carlson, R.D. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The United States Department of Enegy (USDOE) Waste Transportation Management Division (WMTD) has commissioned the development of a transportation tracking management and communication system to monitor movement of radioactive material shipments throughout the United States. The system, TRANSCOM, is being developed to enhance DOE's management oversight and operational control over the transport of sensitive materials (e.g., spent fuel, highlevel waste, transuranic waste etc.) and to address state and local government concerns regarding public safety. These goals are accomplished through providing a near real time tracking and communication system complete with information database management to support emergency response capabilities.

39933 **TRANSNET.** Cashwell, J.W. (Sandia National Labs., Albuquerque, NM (US)); Erickson, C.M.; Kern, E.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The TRANSNET system of transportation risk and systems analysis models and associated data bases was developed to allow access by qualified users to information and techniques developed under the sponsorship of the Department of Energy (DOE) Office of Defense Programs. The TRANSNET system allows outside users to access the RADTRAN III transportation risk analysis model as well as associated logistics, cost and network models and data. TRANSNET contains the most recent versions of models developed under DOE sponsorship. Code modifications that have been made since the last published documentation are noted to the user on the TRANSNET screens. To permit a greater spectrum of users to have access to the models, considerable attention has been given to making them user-friendly and to provide default data sets for typical problems.

39934 **StateGEN/StateNET.** Cashwell, J.W. (Sandia National Labs., Albuquerque, NM (US)); Erickson, C.M. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The StateGEN/StateNET system is designed to allow the user to construct a transportation network on a PC, to assign attributes to the network, and to determine routes based upon a user-specified set of weighted route attributes using the TRANSNET system of transportation risk and systems analysis models.

39935 **Quality assurance aspects in using ductile cast iron for transportation casks.** Sorenson, K.B. (Sandia National Labs., Albuquerque, NM (US)); Salzbrenner, R.J. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

There has been an interest in recent years to assess the suitability of using ductile cast iron (DCI) as the structural containment boundary material for nuclear material transportation casks. This interest is based on the ability to cast to nearly final dimensions and

to cast monolithic casks which eliminate welds in the containment boundary. Also, the low material and fabrication costs provide added incentive for evaluating DCI for cask construction. To date, ferritic materials (including DCI) have not been certified for this application. The principal issue in using ferritic materials is that they can (under certain combined mechanical and environmental conditions) fail in a low energy, brittle type fashion, particularly in the vicinity of a flaw. Also, for thick-walled castings, inevitable variability in material microstructure results in mechanical property variability. To qualify this material for use in transport casks, it is necessary to demonstrate not only that the possibility of brittle fracture is precluded but also that the results are repeatable. That is, the development approach (design, fabrication, and testing) used for a prototype cask for proof tests must be transferable to each production cask.

39936 Mandatory special or dedicated trains for radioactive materials shipments evidence shows they're not needed. Goodman, L.S. (Transportation Management Div., U.S. Dept. of Energy, Washington, DC (US)); Garrison, R.F.; Harmon, L.H. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The rejection of mandatory special or dedicated trains by all responsible Federal agencies for transportation of radioactive materials in shielded casks has a long history. Working with the railroads and the National Academy of Sciences, the ICC adopted standards for transporting radioactive materials in regular freight trains in the mid 1940's. The standards rested primarily on ensuring the integrity of the radioactive materials packaging. AEC, then NRC and DOT, followed the ICC lead, supplementing the licensing rules for casks with a series of performance or stress tests. At no time did these agencies require special trains or special routing for rail casks. Mandatory special trains have too many disadvantages without any proven safety benefit to be worth their high cost to the shipper. The ICC, in a series of litigated cases, found that given the strength of the casks, mandatory special trains were wasteful transportation and an unreasonable railroad practice.

39937 Transport safety through regulatory compliance. Blalock, L.G. (Logistics Management and Services Branch, Oak Ridge Operations Office, U.S. Dept. of Energy, Oak Ridge, TN (US)); Harmon, L.H.; Garrison, R.F. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The U.S. Department of Energy (DOE) has a strong commitment to ensure the safe and efficient transportation hazardous materials (including radioactive) and achieves this goal through compliance with regulations. DOE's commitment to excellence in this area is reflected by its funding and support of training and orientation workshops for its own people and its contractors. Training is the key to regulatory compliance and safe operations are an end result. This paper addresses the DOE's comprehensive training programs, including some new training initiatives.

39938 Brittle fracture. Emerson, E.L. (Sandia National Labs., Albuquerque, NM (US)); Philbin, J.S. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Large ductile cast iron or forged steel storage casks are being considered for use in Independent Spent Fuel Storage Installations or for on-site storage of aged spent fuel. Concern has been expressed over the possibility of brittle-fracture failure occurring in these kinds of casks when subjected to an explosive attack. One of the objectives of safeguards-related experiments performed at Sandia National Laboratories in 1986 was to characterize the failure of a thick metal wall when subjected to a penetrating high energy device. Test results and conclusions are described in this paper.

39939 The development of an international standard problem set for thermal code evaluation. Glass, R.E. (Sandia National Labs., Albuquerque, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

During a preparatory meeting in Paris on June 21-22, 1979, interest was expressed by most Nuclear Energy Agency (NEA) member countries in exchanging information and experience on various aspects of spent fuel transportation. The result of this meeting was the establishment of working groups under the auspices of the Committee on Reactor Physics (CRP) in the ares of heat transfer, criticality, and shielding. The heat transfer group was established to define a set of cask-like thermal problems and to provide solutions. The problem set and its solutions are available to benchmark computer codes.

39940 TRU waste certification. Hunter, E.K. (U.S. Dept. of Energy (US)); Johnson, J.E. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Waste Isolation Pilot Plant (WIPP) established a policy that requires each waste shipper to verify that all waste shipments meet the requirements of the Waste Acceptance Criteria (WAC) prior to being shipped. This verification provides assurance that TRU wastes meet the criteria while still retained in a facility where discrepancies can be immediately corrected. In this manner, problems that would arise if WAC violations were discovered at the receiver, where corrective facilities are not available, are avoided. Each Department of Energy (DOE) TRU waste facility planning to ship waste to the WIPP is required to develop and implement a specific program including Quality Assurance (QA) provisions to verify that waste is in full compliance with WIPP's WAC. This program is audited by a composite DOE and contractor audit team prior to granting the facility permission to certify waste. Only certified waste may be shipped to the WIPP, and periodic reaudits ensure continued compliance.

39941 Mathematical modeling of copper container corrosion. Walton, J.C. (Pacific Northwest Lab., Richland, WA (US)); Sagar, B. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

A conceptual model is defined for bounding of general corrosion rates of copper when used for containment of high level nuclear waste. The model is implemented in a general, two dimensional finite different code. The code can be used for estimating performance implications of differing design options.

39942 Spent fuel treatment to allow storage in air. Williams, K.L. (Idaho National Engineering Lab., EG and G Idaho, Inc. (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

During Fiscal Year 1987 (FY-87), research began at the Idaho National Engineering Laboratory (INEL) to develop a treatment material and process to coat fuel rods in commercial spent fuel assemblies to allow the assemblies to be stored in hot (up to 380^{0}C) air without oxidation of the fuel. This research was conducted under a research and development fund provided by the U.S. Department of Energy (DOE) and independently administered by EG and G Idaho, Inc., DOE's prime contractor at the INEL. The objectives of the research were to identify and evaluate possible treatment processes and materials, identify areas of uncertainty, and to recommend the most likely candidate to allow spent fuel dry storage in hot air. The results of the research are described: results were promising and several good candidates were identified, but further research is needed to examine the candidates to the point where comparison is possible.

39943 Dry Rod Consolidation Technology Project results. Mullen, C.K. (Idaho National Engineering Lab., EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID (US)); Feldman, E.M.; Vinjamuri, K.; Griebenow, B.L.; Lynch, R.J.; Arave, A.E.; Hill, R.C. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste

management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Dry Rod Consolidation Technology (DRCT) Project conducted at the Idaho National Engineering Laboratory (INEL) in 1987 demonstrated the technical feasibility of a dry horizontal fuel rod consolidation process. Fuel rods from Westinghouse 15 x 15 pressurized water reactor (PWR) spent fuel assemblies were consolidated into canisters to achieve a 2:1 volume reduction ratio. The consolidation equipment was operated at an existing hot cell complex at the INEL. The equipment was specifically designed to interface with the existing facility fuel handling and operational capabilities and was instrumented to provide data collection for process technology research. During the operational phase, data were collected from observation of the consolidation process, fuel assembly handling, and fuel rod behavior and characteristics. Equipment performance was recorded and data measurements were compiled on crud and contamination generated and spread. Fuel assembly skeletons [non-fuel bearing components (NFBC)] were gamma scanned and analyzed for isotopic content and profile. The above data collection was enhanced by extensive photograph and video documentation. The loaded consolidation fuel canisters were utilized for a test of the Transnuclear, Inc. TN-24P dry storage cask with consolidated fuel. The NFBC material was stored for a future volume reduction demonstration project.

0510 Marketing, Economics, and By-products

Refer also to citation(s) 39937, 40023, 40041, 40046, 40073

39944 Commercial use of byproduct cesium as an irradiation source. Chin, A. (Radiation Sterilizers Inc., Menlo Park, CA (US)); Fairand, B.P.; Tingey, G.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Byproduct cesium was recovered from Hanford nuclear waste following removal of the plutonium product and recovery of the enriched uranium from the spent nuclear fuel. The major incentive for recovery of the cesium, along with strontium, was reduction of the heat-generation rate in the waste tanks. Removal of these two heat-producing chemical species results in more than 90% reduction in heat generation in neutralized waste from 1-year-old fuel, and thus, much lower temperatures result in the tanks. The cesium was recovered from the Hanford waste stream beginning in 1967 and was purified and encapsulated from 1974 to 1983, resulting in 1576 capsules containing a total of about 75 MCi of ^{137}Cs. Although these capsules were designed to ease the handling of the waste, they also have substantial potential for use in industrial irradiators. Cesium-137 had been used in some experimental irradiators and in special medical and blood irradiators where the longer half-life than the commonly used ^{60}Co (5.27 years) is desirable, but industrial irradiator operators showed little interest in using the capsules produced at the Hanford Waste Encapsulation and Storage Facility (WESF) until 1984 when the situation changed dramatically with a worldwide shortage of ^{60}Co.

0520 Waste Management

Refer also to citation(s) 39908, 39909, 39910, 39911, 39914, 39915, 39916, 39931, 39932, 39944, 40058, 40064, 40066, 40067, 40068, 40069, 40070, 40072, 40074, 40075, 40088, 40089, 40090, 40204, 40476, 40483, 40514, 40545, 40570, 40574, 40670, 40677, 40688, 40689, 40691, 40918, 40920, 40922, 40923, 40970

39945 (AERE-R–12957(Rev.)) **Colloids related to low level and intermediate level waste. Progress report for the period 1st January to 31st December 1987.** Ramsay, J.D.F.; Russell, P.J.; Avery, R.G. UKAEA Harwell Lab. (UK). Chemistry Div. Jan 1988. 48p. (DOE-RW–89.002). Available from H.M. Stationery Office, London, price Pound 10.50.

Experimental investigations have been carried out on the processes in which colloids are generated in cement leachates. Particular emphasis has been given to the chemical characterisation of leachates derived from cements of different composition (OPC; OPC/BFS; OPC/PFA). Elemental data have been obtained on the liquid and particulate fractions in the leachates. Tests were conducted at both ambient and elevated temperatures and were extended to longer timescales. An appreciable release of cement elements was observed, including those (Al, Si, Ca) likely to be significant in forming colloids. The release of trace elements (Co, Ni, Ce, Eu, Th, U) from spiked cement (OPC) was also measured. Their release appeared to be largely associated with the particulate phase. The important influence of near-field water chemistry on the properties of colloids which may be typical of those found in groundwater has also been demonstrated. (author).

39946 (AERE-R–13369) **Repository system simulation test (granite repository). Final report 1988.** Boult, K.A.; Hough, A.; Marples, J.A.C.; Robertson, G.P. UKAEA Harwell Lab. (UK). Chemistry Div. Sep 1988. 66p. (DOE-RW–89.020). Available from H.M. Stationery Office, London, price Pound 12.00.

Results are reported that were obtained as part of the European Communities Round Robin on the Repository System Simulation Test. The leach rates of simulated vitrified waste were obtained under conditions that resemble those likely to occur in a high-level waste repository in granite. In addition, the concentrations were measured of various elements that were released from the glass including Tc, Np, Pu and Am. (author).

39947 (CONF-890854–6) **Model validation lessons learned: A case study at Oak Ridge National Laboratory.** Ketelle, R.H.; Lee, R.R.; Bownds, J.M.; Rizk, T.A. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 11. annual DOE low level waste management conference; Pittsburgh, PA (USA); 22-24 Aug 1989. Order Number DE89015900/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A groundwater flow and contaminant transport model validation study was performed to determine the applicability of typical groundwater flow models for performance assessment of proposed waste disposal facilities at Oak Ridge, Tennessee. Standard practice site interpretation and groundwater modeling resulted in inaccurate predictions of contaminant transport at a proposed waste disposal site. The site's complex and heterogeneous geology, the presence of flow dominated by fractured and weathered zones, and the strongly transient character of shallow aquifer recharge and discharge combined to render assumptions of steady-state, homogeneous groundwater flow invalid. The study involved iterative phases of site field investigation and modeling. Prior to initial modeling, which involved conventional applications of a porous medium code, the site geology and geohydrology were intensively characterized and a groundwater dye tracer test was performed to obtain data against which model results could be compared to test accuracy. The initial site groundwater model incorporated the assumptions of horizontally layered, homogeneous but anisotropic aquifer materials. Simulations using this approach failed to accurately simulate the dye tracer behavior because of poor resolution of the heterogeneous site conditions. 7 figs.

39948 (DOE/NE/44139–24) **Meteorological monitoring and airborne radionuclide dispersion modeling at the West Valley Demonstration Project.** Christiansen, J.H.; Eagan, R.C.; Nicholas, G.W.; Englert, J.P. West Valley Nuclear Services Co., Inc., West Valley, NY (USA); Dames and Moore, West Valley, NY (USA). West Valley Demonstration Project. Sep 1986. 88p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89009018/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Numerous atmospheric dispersion models have been developed for use in the nuclear industry. Such models are used to determine relative concentrations of airborne radionuclides at various locations as a result of routine or accidental releases from nuclear facilities. These concentrations are required input to dose assessments for environmental and safety analyses. The West Valley Demonstration Project (WVDP) has developed and implemented a meteorological program to address the effects of complex hill and valley terrain upon dispersion of the project's atmospheric releases. Wind, temperature, and atmospheric stability data collected from seven different locations near the site over a complete annual cycle were

used as input to a wind field model. The wind fields were constructed by using the data measured at the various locations and interpolating between the measurement sites on a two dimensional grid. Due to the availability of representative terrain-influenced wind measurements, the effects of local surface roughness, terrain channeling and sheltering, and surface heating and cooling were explicitly factored into the placement of wind vectors on the grid. Wind fields were developed to cover the range of meteorological conditions encountered, for every hour in the full year data set. The wind fields thus generated are coupled with a standard variable trajectory Gaussian puff model to develop site-specific relative concentrations (x/Q values) for input to the radiological dose module of the AIRDOS-EPA computer code which then calculates site-specific impacts from the atmospheric pathways for various radiological sources. 16 refs., 15 figs., 38 tabs.

39949 (DOE/NE/44139–47) **Supernatant treatment system design through testing.** Ploetz, D.K.; Leonard, I.M. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Dec 1988. 128p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89009020/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The main purpose of the Supernatant Treatment System (STS) is to remove more than 99.9 percent of the radioactive cesium (Cs-137) from the high-level waste stored in tank 8D-2. Cesium removal is accomplished in the STS by processing the supernatant (liquid) portion of the high-level waste through three or four ion exchange columns filled with zeolite. After treatment in the STS, the decontaminated supernatant is processed as low-level waste and finally encapsulated in cement for eventual disposal. The Cs-137 removed from the waste and absorbed onto zeolite ion exchange material is temporarily stored in tank 8D-1 until it can be encapsulated in glass and disposed of as high-level waste. This report discusses construction and testing of the STS. Design of the STS was started in 1982 in parallel with the selection of the ion exchange material. The construction of this system was accomplished in five phase in parallel with completion of design to allow for faster completion of the project. The existing high-level waste storage tanks – 8D-1, 8D-2, and 8D-3 – required major renovations to permit transfer of the high-level waste from tank 8D-2 to tank 8D-1, to house the components that comprise the STS in tank 8D-1, and to store decontaminated wastes in tank 8D-3. Testing in the STS started before construction was complete and was accomplished by first testing components individually. Then the system was retested using simulated supernatant. Integrated testing of the whole Integrated Radwaste Treatment System (IRTS), which includes the STS, Liquid Waste Treatment System (LWTS), Cement Solidification System (CSS), and the Drum Cell, was also performed using simulated supernatant. Finally, slightly radioactive condensate water from tank 8D-1 was processed. After successfully completing this testing, the STS started operations with radioactive supernatant on May 23, 1988. 21 refs., 33 figs., 21 tabs.

39950 (DOE/NE/44139–49) **Cement waste form qualification report: WVDP [West Valley Demonstration Project] PUREX decontaminated supernatant: Report of work performed for the period of 1983 through 1988.** McVay, C.W.; Stimmel, J.R.; Marchetti, S. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Aug 1988. 158p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89009019/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report provides a summary of work performed to develop a cement-based, low-level waste formulation suitable for the solidification of decontaminated high-level waste liquid produced as a by-product of PUREX spent fuel reprocessing. The resultant waste form is suitable for interim storage and is intended for ultimate disposal as low-level Class C waste; it also meets the stability requirements of the NRC Branch Technical Position on Waste Form Qualification, May 1983 and the requirements of 10 CFR 61. A recipe was developed utilizing only Portland Type I cement based on an inorganic salts simulant of the PUREX supernatant. The qualified recipe was tested full scale in the production facility and was observed to produce a product with entrained air, low density, and lower-than-expected compressive strength. Further laboratory scale testing with actual decontaminated supernatant revealed that set retarders were present in the supernatant, precluding setting of the product and allowing the production of "bleed water." Calcium nitrate and sodium silicate were added to overcome the set retarding effect and produced a final product with improved performance when compared to the original formulation. This report describes the qualification process and qualification test results for the final product formulation. 7 refs., 38 figs., 21 tabs.

39951 (DOE/NE/44139–50) **Low-level waste cement solidification design, installation, and start-up.** Jezek, G.R. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Aug 1988. 19p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89009015/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report describes the design, installation, and start-up activities of the Cement Solidification System (CSS) at the West Valley Demonstration Project (WVDP), West Valley, New York. The CSS, designed to operate within an existing process cell, automatically and remotely solidifies low-level nuclear waste by mixing it with Portland Type I cement. The qualified waste form mixture is placed into square, 270-litre (71-gallon) metal drums. The drums have an integral polyethylene liner to protect the carbon-steel material from potential corrosion. The CSS produces drums at a continuous operation rate of four drums per hour. All system processing data is monitored by a computerized Data Acquisition System (DAS). 6 figs.

39952 (DOE/RL–89-05) **Implementation plan for Hanford Site compliance with US Department of Energy Order 5820.2A.** Westinghouse Hanford Co., Richland, WA (USA). Apr 1989. 107p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE89015387/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This document is the plan of the Department of Energy, Richland Operations Office to achieve compliance with DOE 5820.2A, Radioactive Waste Management. The plan describes activities, costs, and completion dates to achieve compliance with requirements for the management of radioactive and mixed wastes. 26 refs., 7 figs.

39953 (DOE-RW–89.008) **Preliminary radiological assessments of near-surface low-level radioactive waste repositories. Summary report.** Sumerling, T.J.; Nancarrow, D.J. Department of the Environment, London (UK). Aug 1988. 61p. (ANS-R–689-4). Order Number DE89633765/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This report summarises preliminary assessments of post-closure radiological impact of LLW repositories at four sites previously under investigation by UK Nirex Ltd. The objectives of the assessments were: to demonstrate a methodology for site specific assessments, to identify important information requirements for detailed assessments; to identify methodological and research requirements. Doses and risks due to groundwater pathways, human intrusion, gaseous release and natural environmental change are estimated. (author).

39954 (DOE-RW–89.018) **Report on Stage 1 of project CHEMVAL/MIRAGE: verification of speciation models.** Read, D.; Broyd, T.W. Department of the Environment, London (UK). 1989. 359p. Order Number DE89633766/JAW. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

This report describes the results of CHEMVAL Stage 1, an international chemical model verification exercise involving the active participation of 14 organisations within the CEC countries, Sweden, Switzerland and Finland. Five case systems were studied, namely, cement, clay, sandstone, granite and limestone. Overall, good agreement was obtained even for conceptually difficult geochemical simulations. Reasons for divergence in results have been explored and recommendations are made at the appropriate stages for enhancement of the thermodynamic database. A listing of the preliminary CHEMVAL Project Database is provided. (author).

39955 (DOE-RW–89.030) **Assessment of the radiological risks of underground disposal of solid radioactive wastes.** Thorne, M.C. Department of the Environment, London (UK). Dec 1988. 30p. (EWE–2618.032). Order Number DE89633768/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

One of the general principles for assessing proposals for operating a landbased facility for solid radioactive waste disposal is that the site should be chosen and the facility should be designed so that the risk or probability of fatal cancer, to any member of the public, from any movement of radioactivity from the facility, is not greater than 1 in a million in any one year. This report provides advice to the Department of the Environment as to how this risk may be defined and gives a prescription for how it can be calculated. (author).

39956 (DOE/RW–0243) **OCRWM [Office of Civilian Radioactive Waste Management] publications catalog.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Aug 1989. 302p. Sponsored by U.S. DOE Radioactive Waste Management. Available from OSTI.

The US Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) is publishing this catalog to provide citations of selected technical and public information on the subject of high-level radioactive waste management. The catalog is a resource and reference tool that is updated and printed periodically. The online catalog is available for review through OCRWM's Product Record System (PRS) and is available to the public. The printed catalog version is suitable for libraries and those individuals needing either a broad base of information or a particular source; the computerized catalog version provides the most current information resources available, since updates to citations are made as they are received. The number of documents suitable for listing in this catalog is expected to grow significantly each year.

39957 (EPRI-NP–5934, pp. 1.3-1.13) **Radwaste reduction by addition of bodyfeed to the Condensate Demin System.** Jones, R.R. (Georgia Power Company, Baxley (USA)). Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

At Plant Hatch, we have attempted in recent years to satisfy two management requirements: (1) Improve water chemistry and at the same time (2) try to reduce the volume of solid radwaste produced. Better water chemistry, however, tends to require more frequent demineralizer changeouts which produces more spent resin - not less. Several attempts were made to increase the efficiency of the Condensate Demin system, but our run lengths remained around seven days. We learned that the Swedish and Italians were experiencing dramatically extended condensate demineralizer run lengths by bodyfeeding a fiber material into the process stream upstream of the condensate demineralizers. In July, 1985, Plant Hatch committed to installation of Bodyfeed systems of the Swedish/Italian design. In November, 1985, the Unit Two system was operational and in January, 1986, the Unit One system was put into service. Condensate demin run lengths have increased dramatically since 1985. This improvement has been mainly attributed to the Bodyfeed system. The projected 1987 runlengths are 270% longer for Unit 1 and are 180% longer for Unit 2 than in 1985. As you would expect, demin resin usage has decreased likewise. In 1985, it cost approximately $95 for burial of spent condensate demin resin used to produce 1000 MWE-Hour. In 1986, it cost $70 for burial of spent condensate demin resin used to produce 1000 MWE-Hours. For 1987, it is projected to cost $47 for the same. This constitutes a savings of up to $300,000 a year per unit depending on capacity factor. Bodyfeed also helped improve our water chemistry.

39958 (EPRI-NP–5934, pp. 10.3-10.11) **Installation and operation of a hollow fiber filtration system for secondary liquid waste processing at Callaway Plant.** Ridgel, J.A. (Callaway Nuclear Plant, Fulton, MO (USA)); Small, J.F. Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Callaway Nuclear Plant is an 1150 MW Westinghouse PWR with Deep Bed Condensate Polishers. During early operation, we experienced difficulties in cleaning the regenerate waste streams from these polishers sufficient to meet NPDES limitations with the installed filters. Temporary disposable filters were installed and investigation was started for a permanent replacement filter system. We tested several filters including a disposable fiber wound cartridge filter, a disposable pleated paper filter, a backflushable sintered metal filter, and the hollow fiber filter. The hollow fiber filter was selected and installation completed in October 1986. Operation to this point has been very satisfactory.

39959 (EPRI-NP–5934, pp. 12.3-12.23) **Applications for alternative disposal of very low level radioactive waste.** Lan, C. (Duke Power Company, Charlotte, NC (USA)); Schulte, J.H. Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Existing NRC regulations provide no minimum level of radioactivity in waste from a licensee's facility that may be disposed of in a manner other than as radioactive waste. With one exception, in 10CFR§20.306, licensees may dispose of certain levels of tritium and carbon-14 in liquid-scintillation and animal-carcass waste without regard to its radioactivity. In the interim, before specific or generic provisions for disposing of very low level radioactive wastes are adopted through rule making, licensees have another alternative for obtaining approval to dispose of large volumes of materials contaminated with very low levels of radioactivity under provision 10CFR§20.302(a) Method for obtaining approval of proposed disposal procedures. This paper provides the experiences of obtaining both NRC and State (North Carolina and South Carolina) approval for disposing of very low-level radioactive wastes from Duke Power Company's nuclear stations. The approved disposal procedures include land-farming of water treatment residues, sewage sludge and contaminated soil; on site disposal (burial) of decontamination sands, contaminated feedwater heaters and replaced moisture separator reheater tube bundles; and offsite release of sanitary sludge for treatment work and disposal. In summary, users of radioactive materials should not exclude this approach in their quest to reduce the volume of radioactive waste. It is expected that such submittals will provide a data base for further development of generic limits for radioactive wastes.

39960 (EPRI-NP–5934, pp. 13.3-13.14) **Hydro Nuclear Dry Active Waste Volume Reduction System at River Bend Station.** Anthony, T. (Gulf States Utilities, St Francisville, LA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The cost of disposing radioactive waste is continuing to climb. This, combined with other factors, is generating increasing interest in volume reduction systems. In October 1986, Gulf States Utilities Company installed a self-contained Hydro Nuclear Dry Active Waste Volume Reduction System at River Bend Station. This paper discusses procurement justification, operational characteristics, operational history for the first seven months of service, cost savings, problems, and down time.

39961 (EPRI-NP–5934, pp. 2.3-2.18) **Root cause analysis for wet waste generation.** Stoner, P.J. (Florida Power & Light Company, Juno Beach (USA)); Daloisio, G.S. Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Since, typically, most utility radioactive waste is dry waste, volume reduction efforts should start with this. However, significant cost can still be saved with a modest reduction in the wet radioactive waste volume. Even though there may be several potential solutions to wet waste volume reduction, a Root Cause Analysis

should be performed to identify the solution that will be the most effective for volume reduction. The method described here provides for a logical sequence of determining root causes. Finally, the solution adopted must be evaluated after implementation to determine its effectiveness and verify that the root cause was addressed.

39962 (EPRI-NP–5934, pp. 4.3-4.11) **Evaluation of selective ion exchange to process liquid radwaste at Susquehanna.** Vance, J.N. Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

EPRI sponsored this engineering evaluation of the use of selective ion exchange to process liquid radwaste (LRW) at Susquehanna. This focused on the benefits and impacts of using selective ion exchange, however, it did not evaluate specific selective ion exchange technologies available for this application. Overall, it appears that the use selective ion exchange media for processing LRW at Susquehanna can be implemented with little or no changes to existing systems. The processing capacities of the radwaste and Make-up Systems are adequate to accommodate the discharge mode. It will be necessary to maintain the Make-up Water Treatment System in sound working order to achieve the water quality and system processing capacities required for the discharge mode. The environmental doses are likely to be somewhat higher than are now being achieved, but should still remain a small fraction of Appendix I guidelines. The use of selective ion exchange processing will essentially eliminate in-plant sources of organic. At reasonable low run length ratios, the economics will favor the use of selective ion exchange over conventional organic resin.

39963 (EPRI-NP–5934, pp. 5.3-5.25) **EPRI Below Regulatory Concern program.** Robinson, P. (EPRI, Palo Alto, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

EPRI has sponsored a low-level radioactive waste program called Below Regulatory Concern (BRC). The major objective of the BRC project is the exemption of very low activity waste streams from NRC regulation. The potential industry benefit is $20-25 million per year in disposal costs only.

39964 (EPRI-NP–5934, pp. 7.3-7.14) **Annual update of transportation and Barnwell disposal of radioactive material.** Lewis, M.S. Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The following information is provided as an update on the transportation of radioactive material. Topics covered include changes to transportation regulations that have occurred from early 1986 to present, future regulatory changes, current concerns, and interpretations of common problems. An update is also provided on the disposal of low-level radioactive waste at the Barnwell Waste Management Facility. Topics covered include changes to license conditions, site criteria, and South Carolina Department of Health and Environmental Control (DHEC) correspondence.

39965 (EPRI-NP–5934, pp. 9.3-9.10) **Project management of radwaste retrofits.** Vaught, D.L. (Duke Power Company, Charlotte, NC (USA)). Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Many utilities are finding it necessary to provide additional radioactive waste processing facilities at operating or nearly completed nuclear stations in order to accommodate the ever-changing regulatory, political and socio-economic environment in which we operate. This paper describes the project approach taken at Duke Power Company to provide a comprehensive radioactive waste processing facility at Oconee Nuclear Station. Following a historical perspective, the philosophy and mechanics of the project team are discussed. The goal of the project team was to provide a facility which could meet the liquid and solid radioactive waste processing needs of Oconee within the restraints of a utility budget and schedule. The unique quality of the project team approach was the integral involvement of all of the necessary departments in every part of the design, construction and start-up phases. The project team thereby utilized feedback from over thirty reactor years of operational experience. The remainder of the paper provides examples of the problems encountered and their resolution (eg. equipment layout, materials handling, vendor improvements and regulatory changes all required design-in-progress changes). It has been the integration and concentration of the diverse resources of a large utility into a cross-departmental team which has allowed the timely resolution of the necessary changes. This same philosophy is being applied to the facility start-up program and to other major projects at Duke Power Company.

39966 (EPRI-NP–6440) **Validation of CELL-2 calculations for predicting the isotopic content of exposed LWR fuel: Final report.** Williams, M.L. Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Power Div.; Louisiana State Univ., Baton Rouge, LA (USA). Nuclear Science Center. c Jul 1989. 140p. Sponsored by Electric Power Research Institute. Available from Researach Reports Center, Box 50490, Palo Alto, CA 94303.

The one-dimensional pin-cell analysis code CELL-2 has recently been released by EPRI as part of a major core physics design package referred to as ARMP-02. Within this package, CELL-2 is used to parameterize different sections of a fuel assembly (fuel cell, burnable poison cell, guide tube, etc.) at different exposure points and under different core conditions (moderator and fuel temperature, void or soluble boron concentration, etc.). The adequacy of CELL-2 for core physics calculations has been validated in the ARMP-02 documentation. The objective of the present work is to demonstrate its suitability for use in calculating the isotopic compositions of spent fuel. To validate the accuracy of CELL-2 calculations performed with the ENDF/B-V cross section libraries, six experiments for which measured isotopics data is available have been analyzed. This study demonstrates that CELL-2, using the ENDF/B-V cross section library, produces reliable predictions for the isotopics of exposed fuel. The calculated results nearly always agree within 5% of the measured values, and are most often within the claimed experimental uncertainty of the measurements. In the few instances where the disagreement exceeds 5%, the cause can usually be attributed to significant non-uniformities in the reactor lattice configuration, for which the one-dimensional supercell model in CELL-2 is expected to break down, or to uncertainties in the fuel temperatures. Therefore the present results, along with the conclusions of the earlier work, provide strong evidence that the ENDF/B-V CELL-2 code will be able to accurately predict the reactivity of exposed LWR fuel pins in addition to their isotopic contents. 32 refs., 13 figs., 32 tabs.

39967 (ETEC–89-3) **Building 059: Phase 1 Pipe Chase Room Remediation.** Meyer, R.D.; Horton, P.H.; Neely, H.H. Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center. 23 Jun 1989. 37p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC03-76SF00700. Order Number DE89014331/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report documents the Phase I activities and results of the Building 059 Remediation project. The project consisted of removing, packaging, and shipping approximately 30 linear feet of 5-ft-dia activated steel vacuum duct and supports, over 100 tons of activated sand, and miscellaneous other radioactive waste for burial at the DOE radioactive burial site in Hanford, Washington. A total of 4562 ft^3 of low specific activity waste was disposed of during the project. Following removal of the activated materials, the region of water intrusion into the Pipe Chase Room was identified and sealed. All technical objectives of the Phase I portion of the project were achieved.

39968 (EUR–11848) **Long-term rheological and transport properties of dry and wet salt rocks.** Spiers, C.J.; Peach, C.J.; Brzesowsky, R.H.; Schutjens, P.M.T.M.; Liezenberg, J.L.; Zwart, H.J. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 161p. Available from NTIS (US Sales Only), PC A08/MF A01.

This report forms a final report on Aims 1 to 3 of Contract No FI1W-0051-NL. It is opened in Section 2 with a consideration of the theoretical background necessary for a state-of-the-art treatment of compaction creep in granular salt and backfill materials (Aim 3). Fundamental experimental work on compaction creep in wet and dry salt aggregates is presented in Sections 3 and 4 respectively. In Section 5 this is extended to investigate the influence of backfill variables (such as brine content, grain-size distribution, and additives content) on the compaction creep behaviour of granular salt, and to develop a generally applicable constitutive law for salt backfill and cement materials. In Section 6 an optimal (i.e. fast-compaction/retention-efficient) backfill recipe is proposed. Experiments designed to test/verify the applicability of our general constitutive law to this recipe, to determine its permeability versus porosity characteristics, and to clarify the very long term properties and microstructure of both backfill and cement, are also reported. The conclusions drawn complete our work on backfill. Section 7 deals with work done on the long-term constitutive behaviour of salt rock (Aim 1) and on creep-induced dilatancy (Aim 2). Investigations into the permeability characteristics of dilated salt and (fractured) anhydrite rock are reported in Section 8. The report is terminated in Section 9 with an overall summary of results and conclusions.

39969 (EUR–11896) **Natural analogues and evidence of long-term isolation capacity of clays occurring in Italy Contribution to the demonstration of geological disposal reliability of long-lived wastes in clay.** Benvegnu, F.; Brondi, A.; Polizzano, C. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 101p. Available from NTIS (US Sales Only), PC A06/MF A01.

This work concerns the results of the studies conducted at many sites in Italy aimed at collecting information on natural evidences of the isolation capacity of clay. Field observations allow to get the opportunity to know directly or infer the evolutive geological processes which are of concern for the waste disposal problems. As a major advantage such observations concern natural phenomena acting at the same, or at a greater, time-space scale involved in the geological disposal of wastes. The explored situations regard the secondary permeability of clay, detected by means of natural tracers (Hg, He, hydrothermal and geothermal fluids, ...) at the ground surface or directly studied in deep civilian tunnels. Another treated topic is the meaning of the oxido-reduction front as a control factor of the physico-chemical environment of clay as well as of the radionuclides migration. The mechanical and thermal effects which accompany the intrusion of a subvolcanic body within clay represent an extreme worst case for a comparison of the effects on clay due to heat developed by radionuclide decay. Finally the case of a fossil forest maintained almost inaltered by the clay cover for over 1,500,000 years is described. All the results of the geological researches point univocally to an almost total and long lasting isolation capacity of clay formations.

39970 (EUR–12024) **Role of organics on the migration of radionuclides in the geosphere.** Carlsen, L. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 76p. Available from NTIS (US Sales Only), PC A05/MF A01.

The present report summarizes factors of importance concerning the role of organics on the migration of radionuclides in the terrestrial environment. Following some introductory remarks (chapter 1), chapter 2 describes the occurrence of organic compounds in the geosphere, taking both naturally occurring as well as artificially introduced compounds into account. The behaviour of organic compounds in the terrestrial environment is summarized (chapter 3) with special emphasis on sorption and persistence in the environment. Both chemical and microbiological degradation reactions are discussed. Chapter 4 describes the fundamentals of complex formation in relation to migration. Stability constants for the interactions between relevant metal ions and low molecular weight ligands as well as with humic- and fulvic acids are summarized. Chapter 5 is devoted to an evaluation, based on theoretical considerations, of the influence of organics on the migration behaviour of radionuclides in the terrestrial environment. Additionally, the behaviour of two special elements, i.e. technetium and iodine, is discussed.

39971 (EUR–12052) **Directory of computer codes suitable for stress analysis of HLW containers - Compas project.** Anon. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 49p. Available from NTIS (US Sales Only), PC A03/MF A01.

This document reports the work carried out for the Compas project which looked at the capabilities of various computer codes for the stress analysis of high-level nuclear-waste containers and overpacks. The report concentrates on codes used by the project partners, but also includes a number of the major commercial finite element codes. The report falls into two parts. The first part of the report describes the capabilities of the codes. This includes details of the solution methods used in the codes, the types of analysis which they can carry out and the interfacing with pre - and post - processing packages. This is the more comprehensive section of the report. The second part of the report looks at the performance of a selection of the codes (those used by the project partners). This look at how the codes perform in a number of test problems which require calculations typical of those encountered in the design and analysis of high-level waste containers and overpacks.

39972 (EUR–12053) **Stress analysis of HLW containers. Compas project.** Anon. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 69p. Available from NTIS (US Sales Only), PC A04/MF A01.

This document reports the work carried out for the Compas project which looked at the performance of various computer codes in a selected benchmark exercise. This exercise consisted of several analyses on simplified models which have features typical of HLW containers. These analyses comprise two groups; one related to thick walled, stressed shell overpacks, the other related to thin walled, supported shell overpacks with a lead filler. The first set of analyses looked at an elastic-plastic behaviour and large deformation of a cylinder representative of the main body of thick walled containers. The second set looked at creep behaviour of the lead filler, and the shape the base of thin walled containers will take up, after hundreds of years in the repository. On the thick walled analyses with the cylinder subject to an external pressure all the codes gave consistent results in the elastic region and there is good agreement in the yield pressures. Once in the plastic region there is more divergence in the results although a consistent trend is predicted. One of the analyses predicted a non-axisymmetric mode of deformation as would be expected in reality. Fewer results were received for the creep analysis, however the transient creep results showed consistency, and were bounded by the final-state results.

39973 (EUR–12062) **Investigation of whether various types of radioactive waste are equivalent in terms of the radiological impact associated with their disposal.** Fearn, H.S.; Smith, G.M.; Davis, J.P.; Hill, M.D. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 58p. Available from NTIS (US Sales Only), PC A04/MF A01.

The aim of this study is to investigate the possibility that various types of waste are equivalent in terms of the risks associated with their disposal in so far as they are viewed by different sections of society. If such a framework can be established it could be used as an aid to decisions as to whether central disposal facilities, to accept waste from several countries, should be constructed. Details are presented of assumed radionuclide inventories for a representative range of radioactive wastes, calculations and results of the radiological impacts of their disposal, and illustrative methods for weighting the various components of impact which when summed provide an overall measure of impact. Five sets of weighting factors have been devised which are intended to represent the views of (a) the radiological protection community, (b) those with a pro-nuclear industry view, (c) those who oppose nuclear power on safety grounds, (d) the inhabitants of the country receiving wastes for disposal, and (e) the inhabitants of the country dispatching wastes. On the basis of the calculated weighted radiological impacts it is demonstrated how conclusions can be drawn about general views on the disposal of

each waste, about likely attitudes to the export of wastes from one country for disposal in another, and attitudes to exchanging wastes between countries. The study is preliminary and of limited scope. However, the results show that the general methodology is practicable and could be applied in a wider ranging investigation.

39974 (LA–11452-MS) **Statistical test of reproducibility and operator variance in thin-section modal analysis of textures and phenocrysts in the Topopah Spring member, drill hole USW VH-2, Crater Flat, Nye County, Nevada.** Moore, L.M.; Byers, F.M. Jr.; Broxton, D.E. Los Alamos National Lab., NM (USA). Jun 1989. 47p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-36. Order Number DE89015327/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A thin-section operator-variance test was given to the 2 junior authors, petrographers, by the senior author, a statistician, using 16 thin sections cut from core plugs drilled by the US Geological Survey from drill hole USW VH-2 standard (HCQ) drill core. The thin sections are samples of Topopah Spring devitrified rhyolite tuff from four textural zones, in ascending order: (1) lower nonlithophysal, (2) lower lithopysal, (3) middle nonlithophysal, and (4) upper lithophysal. Drill hole USW-VH-2 is near the center of the Crater Flat, about 6 miles WSW of the Yucca Mountain in Exploration Block. The original thin-section labels were opaqued out with removable enamel and renumbered with alpha-numeric labels. The sliders were then given to the petrographer operators for quantitative thin-section modal (point-count) analysis of cryptocrystalline, spherulitic, granophyric, and void textures, as well as phenocryst minerals. Between operator variance was tested by giving the two petrographers the same slide, and within-operator variance was tested by the same operator the same slide to count in a second test set, administered at least three months after the first set. Both operators were unaware that they were receiving the same slide to recount. 14 figs., 6 tabs.

39975 (NRPB-R–218) **Assessment of subseabed disposal of vitrified high level waste for the PAGIS [Performance Assessment of Geological Isolation Systems] project.** Mobbs, S.F.; Charles, D.; Below, C.E.; McColl, N.P. National Radiological Protection Board, Chilton (UK). Mar 1989. 153p. Available from H.M. Stationery Office, London, price Pound 9.00.

This assessment of the subseabed disposal of vitrified high level waste has been carried out within the CEC PAGIS project using the common methodology agreed for this project. Doses and risks to individuals and time-integrated doses to populations have been calculated for the reference disposal option for a number of different evolution scenarios using best estimate and uncertainty analysis techniques. Free fall penetrates and drilled options are considered. In all cases models selected were verified through use in international intercomparison exercises. (U.K.).

39976 (NUREG/CP–0097-Vol.1, pp. 129-140) **Use of solidification systems and high integrity containers for disposal of low-level waste.** Tokar, M. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

This paper primarily addresses the 10 CFR Part 61 requirements for waste form stability and the use of solidification media and high integrity containers to provide the required stability for Class B and Class C waste. Tests and criteria that are provided in a Technical Position on Waste Form and the current status of NRC's waste form and HIC reviews are also discussed.

39977 (NUREG/CR–5400) **Basis for in-situ geomechanical testing at the Yucca Mountain site.** Board, M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of High-Level Waste Management; Itasca Consulting Group, Inc., Minneapolis, MN (USA). Jul 1989. 112p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A06/MF A01 - GPO - OSTI.

This report presents an analysis of the in-situ geomechanical testing needs for the Exploratory Shaft (ES) test facility at the Yucca Mountain site in Nevada. The testing needs are derived from 10CFR60 regulations and simple thermomechanical canister- and room-scale numerical studies. The testing approach suggested is based on an "iterative" procedure of full-scale testing combined with numerical and empirical modeling. The testing suggested is based heavily on demonstration of excavation and thermal loading of full-scale repository excavations. Numerical and/or empirical models are compared to the full-scale response, allowing for adjustment of the model and evaluation of confidence in their predictive ability. Additional testing may be specified if confidence in prediction of the rock mass response is low. It is suggested that extensive drifting be conducted within the proposed repository area, including exploration of the bounding Drill Hole Wash and Imbricate fault structures, as well as the Ghost Dance fault. This approach is opposed to an a priori statistical specification of a number of "point" tests which attempt to measure a given property at a specific location. 40 refs., 49 figs., 6 tabs.

39978 (ORNL/TM–10700) **Studies on disposal of low-level radioactive wastes in Turkey.** Uslu, I.; Fields, D.E.; Yalcintas, M.G. Oak Ridge National Lab., TN (USA). Aug 1989. 17p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89014368/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Turkish Government is in the process of planning two nuclear reactors in Turkey. Studies have begun for improved control of low level wastes (LLW) in Turkey before establishment of these reactors. In this study, the PRESTO-II (Prediction of Radiation Exposures form Shallow Trench Operations) computer code is used to assess the risk associated with the shallow land disposal of low level waste (LLW) in various sites in Turkey. PRESTO-II is a computer code developed under the United States Environmental Protection Agency, Department of Energy and Nuclear Regulatory Commission funding to evaluate possible health effects from radioactive releases from shallow, radioactive waste disposal trenches and from areas contaminated with operational spillage. A preliminary simulation using the PRESTO-II computer code has been run for the site in Koteyli, Balikesir, Turkey. This example simulation was performed using the same radionuclide data set believed representative of the LLW disposal facility in Barnwell, South Carolina. Site environmental variables were selected to typify credible worst case exposure scenarios. Radionuclide inventories are primarily based on estimated waste composition rather than measured values. 9 refs., 4 figs., 1 tab.

39979 (PNL–6886) **Hanford Site ground-water monitoring for January through June 1988.** Evans, J.C.; Bryce, R.W.; Sherwood, D.R. Pacific Northwest Lab., Richland, WA (USA). May 1989. 552p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014359/JAW. Available from NTIS, PC A24/MF A01 - OSTI; GPO Dep.

The Pacific Northwest Laboratory monitors ground-water quality at the Hanford Site for the US Department of Energy to assess the impact of Site operations on the environment. Work undertaken between January and June 1988 included monitoring ground-water elevations across the Site, and monitoring hazardous chemicals and radionuclides in ground water. Water levels continued to rise in areas receiving increased recharge (e.g., beneath B Pond) and decline in areas where the release of water to disposal facilities has been terminated (e.g., U Pond). The major areas of ground-water contamination defined by monitoring activities are (1) carbon tetrachloride in the 200-West Area; (2) cyanide in and north of the 200-East and 200-West Areas; (3) hexavalent chromium contamination in the 100-B, 100-D, 100-F, 100-H, 100-K, and 200-West Areas; (4) chlorinated hydrocarbons in the vicinity of the Solid Waste Landfill and 300 Area; (5) uranium in the 100-F, 100-H, 200-West, and 300 Areas; and (6) tritium and nitrate across the Site. In addition, several new analytical initiatives were undertaken during this period. These include cyanide speciation in the BY Cribs plume, inductively coupled argon plasma/mass spectrometry (ICP/MS) measurements on a broad selection of samples from the 100, 200, 300, and 600 Areas, and high sensitivity gas chromatography

measurements performed at the Solid Waste Landfill-Nonradioactive Dangerous Waste Landfill. 23 figs., 25 tabs.

39980 (PNL-SA–16553) **Project summary, 116-B-6-1 crib ISV [in situ vitrification] demonstration project.** Koegler, S.S. Pacific Northwest Lab., Richland, WA (USA). Jan 1989. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8901134–1: Project summary presentation for Environmental Protection Agency and Washington State Department of Ecology, Seattle, WA (USA), 12 Jan 1989). Order Number DE89014928/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The 116-B Crib Demonstration Project is intended to demonstrate the emerging in situ vitrification (ISV) technology to immobilize or destroy hazardous and radioactive chemicals at an actual site. In situ vitrification is the conversion of contaminated soil into a durable glass and crystalline product through joule heating. The 116-B crib site was chosen for the demonstration because it contains both radioactive and hazardous chemicals (e.g., chromium) and presents a potential threat to environment. The project will involve sampling and analysis of the soil beneath the crib, a small-scale ISV test to verify operating parameters, vitrification of the crib, and analysis of the vitrified soil. 5 figs.

39981 (PNL-SA–16829) **Slurry feed variability in West Valley's melter feed tank and sampling system.** Fow, C.L.; Kurath, D.E.; Pulsipher, B.A.; Bauer, B.P. Pacific Northwest Lab., Richland, WA (USA). Apr 1989. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890488–9: 4. international symposium on ceramics in nuclear waste management, Indianapolis, IN (USA), 23-27 Apr 1989). Order Number DE89015839/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The present plan for disposal of high-level wastes at West Valley is to vitrify the wastes for disposal in deep geologic repository. The vitrification process involves mixing the high-level wastes with glass-forming chemicals and feeding the resulting slurry to a liquid-fed ceramic melter. Maintaining the quality of the glass product and proficient melter operation depends on the ability of the melter feed system to produce and maintain a homogeneous mixture of waste and glass-former materials. To investigate the mixing properties of the melter feed preparation system at West Valley, a statistically designed experiment was conducted using synthetic melter feed slurry over a range of concentrations. On the basis of the statistical data analysis, it was found that (1) a homogeneous slurry is produced in the melter feed tank, (2) the liquid-sampling system provides slurry samples that are statistically different from the slurry in the tank, and (3) analytical measurements are the major source of variability. A statistical quality control program for the analytical laboratory and a characterization test of the actual sampling system is recommended. 1 ref., 5 figs., 1 tab.

39982 (PtUB–21, pp. 113-129) **Tritium accumulation by the CECE method using high-temperature steam electrolysis.** Keil, W. (Dornier G.m.b.H., Friedrichshafen (Germany, F.R.)); Erdle, E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5806. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

Tritium can be accumulated with methods as have been developed for the extraction of deuterium in heavy-water production: distillation or combined electrolysis catalytic exchange (the CECE method) which is being tested on a commercial scale with tritium at the Institute for Radiochemistry (IRCH) of the nuclear research centre. This study aims at finding out how the process of high-temperature electrolysis (HOT ELLY), instead of conventional liquid-water electrolysis, can be integrated in the CECE process for tritium concentration by means of process engineering. With the HOT-ELLY method, decisive advantages, in particular an essential reduction of the radioactive inventory, can be expected. Safety-related and radiological aspects are discussed with respect, i.a., to their integration in the reprocessing plant in Wackersdorf. (orig./RB).

39983 (PtUB–21, pp. 201-204) **Separation of cesium from nitric acid solutions.** Heckmann, K. (Regensburg Univ. (Germany, F.R.)); Weinrich, K.; Pieronczyk, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5685. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

This study reports on the synthesis of fluorine and alkoxy substituted tetraphenyl borates which are to be used as precipitating agents for the separation of ^{134}Cs and ^{137}Cs from radioactive waste solutions. (RB).

39984 (PtUB–21, pp. 251-264) **Leaching experiments with vitrified HAW in a repository mock-up very close to real conditions.** Froeschen, W. (Heidelberg Univ. (Germany, F.R.). Physikalisch-Chemisches Inst.); Zeisler, S.; Wolf, G.K. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5604. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

In approximation to the real conditions of the final storage of vitrified highly radioactive waste in the Gorleben salt dome, leaching experiments according to standardized methods were carried out together with the simulation of additional parameters. These parameters included: unpacked glasses and glasses packed in precorroded high-grade steel foils, experiments with alternating wet/dry cycles and changed surfaces (volume ratio) as compared to former tests. The loss in weight of the glasses was determined, and the content of Cs, Sr and Mo in the leaching solutions was analysed. It became obvious that the Cs leaching is influenced by the dissolution of the matrix of the unpacked samples, and that on the other hand the influence of steel corrosion products is considerable. (RB).

39985 (PtUB–21, pp. 387-402) **Kinetics of aerosol discharge and particle spectra from vitrification experiments.** Baumgaertner, F. (Technische Univ. Muenchen, Garching (Germany, F.R.). Inst. fuer Radiochemie); Heitz, J.; Krebs, K. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5756. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The studies carried out in the period under report dealt with the periodic development of aerosol discharge in the PAMELA process, as well as with the element composition of the particles relative to their sizes. The aerosol particles were collected with the help of a filter or cascade impactor (fractionation according to the sizes of the particles), and their element composition was analyzed by means of neutron activation, atomic emission spectrometry or X-ray fluorescence. So far, quantitative proofs have been effected for Se, Mo, Ru, Te, Cs, La, Ce, Pr, Nd, Sm and Eu. The distribution on certain particle sizes was complemented by SEM-EDX tests. The discharge kinetics reveals two basically different main mechanisms: 1. formation of boiling and spraying aerosols in the element composition of

the whole melt (simulation product in this case), and 2. selective evaporation of individual elements at high temperatures. (orig./RB).

39986 (SAND–87-2699) **An analysis of the G-Tunnel heated block thermomechanical response using a compliant-joint rock-mass model: Yucca Mountain Project.** Costin, L.S.; Chen, E.P. Sandia National Labs., Albuquerque, NM (USA). Dec 1988. 76p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. Order Number DE89013997/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The results of two-dimensional finite element analyses of several thermal and mechanical loading cycles of the G-Tunnel heated block experiment are presented. The deformations of the block resulting from biaxial and uniaxial loading as well as thermal loading under constant biaxial stress were determined using a recently developed compliant-joint rock-mass model. The results of the finite element calculations were compared to experimental results. Good quantitative agreement between the experimental and numerical results were obtained in most cases. The notable exception was in the analysis of the thermal loading cycles. In some calculations, key model parameters were varied in order to assess the sensitivity of the solution to variation of these parameters. In addition to comparison of numerical and experimental results a major purpose of these analyses was to assess the methods used in the heated block experiment and their impact on the use of such an experiment for thermomechanical model validation. The results of this evaluation are discussed and recommendations regarding the design of future experiments are made. 15 refs., 49 figs.

39987 (WHC-EP–0250-Vol.1) **Hanford waste vitrification plant preliminary safety analysis report: Draft.** Herborn, D.I.; Smith, D.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 457p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015037/JAW. Available from NTIS, PC A20/MF A01 - OSTI; GPO Dep.

This document comprises the safety analysis report for the proposed vitrification plant at the Hanford Reservation. Topics discussed in Volume 1 include a safety analysis, site characteristics, and principal design criteria. (TEM)

39988 Status of defense radioactive waste disposal activities. Wade, T.W. (U.S. Dept. of Energy, Washington, DC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Office of Defense Programs, U.S. Department of Energy, is responsible for the production of nuclear weapons and materials for national defense. As a byproduct to their activities, nuclear production facilities have generated, and will continue to generate, certain radioactive, hazardous, or mixed wastes that must be managed and disposed of in a safe and cost-effective manner. Compliance with all applicable Federal and State regulations is required. This paper describes the principal elements that comprise Defense Programs' approach to waste management and disposal. The status of high-level, transuranic, and low-level radioactive waste disposal is set forth. Defense Programs' activities in connection with the environmental restoration of inactive facilities and with the safe transport of waste materials are summarized. Finally, the principal challenges to realizing the goals set for the defense waste program are discussed in terms of regulatory, public acceptance, technical, and budget issues.

39989 Implementation of the Nuclear Waste Policy Amendment Act of 1988. Issacs, T.H. (Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

On December 21, 1987, Congress passed the Budget Reconciliation Act for Fiscal Year 1988. An integral part of this was some major changes in the Nuclear Waste Policy Act of 1982. These changes are referred to as the Nuclear Waste Policy Amendments Act of 1987. This paper reviews the actions and reactions of USDOE to these major policy changes which have resulted in the termination of site-specific activities of Deaf Smith and Hanford sites and annulled and revoked the USDOE's submitted proposal to Congress to locate a monitored retrievable storage facility in Tennessee.

39990 Three year's progress of the west valley demonstration project vitrification system. Barnes, S.M. (West Valley Nuclear Services Co., Inc., West Valley, NY (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Vitrification equipment designed to solidify the high-level wastes stored at the Western New York Nuclear Service Center has been installed in a cold testing facility at the site. This system has been undergoing checkout and performance testing for approximately three years. This report provides a description of the reference vitrification flow sheet, the process equipment and summarizes integrated equipment testing completed since October 1986, simulated waste slurry processing tests.

39991 Progress in defense high-level waste disposal. Wodrich, D.D. (Westinghouse Hanford Co. (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The U.S. Department of Energy (DOE) is making good progress in its program to dispose of Defense High-Level Waste (DHLW) stored at the Savannah River Laboratory in South Carolina; Hanford Site in Washington; and Idaho National Engineering Laboratory in Idaho. The Defense Waste Processing Facility (DWPF) at Savannah River is more than 65% complete, the Hanford Site has issued its Environmental Impact Statement on disposal alternatives, and Idaho is developing disposal strategy. A decision has been made to dispose of DHLW in the civilian geologic repositories being developed as part of the Nuclear Waste Policy Act (NWPA), and the waste acceptance process has been defined.

39992 Metal toxicity evaluation of Savannah River Plant saltstone comparison of EP and TCLP test results. Langton, C.A. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Saltstone is the waste treatment and disposal concept for low-level defense waste at the Savannah River Plant. The waste is a sodium salt solution which has about 230 5Ci/L in addition to the hazardous characteristics of corrosivity (pH > 12.5) and metal toxicity (Cr^{+6} > 100 ppm). The design objectives for a wasteform to stabilize this solution include: 1) eliminating hazardous characteristics of the waste; and 2) minimizing the release of potential contaminants, such as NO_3_ and radionuclides, so that drinking water standards are maintained for groundwater at the perimeter of the disposal site. Two EPA test procedures are routinely used at SRP to evaluate metal toxicity of wastes and wasteforms. These tests are: 1) the Extraction Procedure (EP) and; 2) the Toxicity Characterization Leaching Procedure (TCLP). The EP test is required by SCDHEC and EPA. The TCLP is used to evaluate the effect of increased surface area on metal leaching from the various SRP wasteforms.

39993 DOE technologies and demonstrations in low-level waste management. Sleeman, R.C. (Waste Management Branch, Oak Ridge Operations Office, Oak Ridge, TN (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

To respond to regulatory concerns, the U.S. Department of Energy (DOE) has recently placed an increased emphasis on developing, demonstrating, and implementing new technologies for management of low-level radioactive waste (LLW) at its facilities throughout the nation. A major component of this (LLWDDD) Program at Oak Ridge Operations facilities. The LLWDDD Program has

four main components: reduction of waste volume, development of interim waste storage capacity, demonstration of innovative waste management technologies, and improved implementation of waste management technologies. Several demonstrations of LLW disposal technologies have already taken place, and more are planned. Based on preliminary assessments, the LLWDDD Program had developed four classes of waste. The classification system is considerably more restrictive than the system used in 10 CFR 61 account for shortcomings in disposal sites.

39994 The department of energy program for environmental restoration. George, C.H. (Dept. of Energy, Washington, DC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

For more than forty years the U.S. Department of Energy (DOE) and its predecessor agencies have operated a vast industrial enterprise to produce nuclear materials and nuclear weapons for the national defense. Like other heavy industry world-wide, this industrial activity has managed and disposed of its wastes according to accepted practices that have later come to be questioned. Environmental laws and regulations have tightened the standards for hazardous substance control to reflect society's growing awareness of the persistence of many toxic substances in the environment and the need to protect land and environment for future use. As in the private industrial sector, the Department inherits a legacy of contaminated sites from its historical operations that must, under current law, at least be examined and considered for remedial action.

39995 Activities in department of energy hazardous and mixed waste defense waste management. Eyman, L.D. (Hazardous Waste Remedial Actions Program Support Contractor Office, Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

In January 1986, the U.S. Department of Energy (DOE) Office of Assistant Secretary for Defense Programs (DP) created the Hazardous Waste and Remedial Actions Division within the Office of Defense Waste and Transportation Management. The Oak Ridge Operations Office (ORO) was assigned the responsibility for supporting DOE Headquarters (HQ) in planning nationally integrated activities for Resource Conservation and Recovery Act/ Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act (RCRA/ CERCLA/SARA) compliance. In turn, ORO created the Hazardous Waste Remedial Actions Program Support Contractor Office (HAZWRAPSCO) to assist with the expanded lead assignment. The HAZWRAPSCO activities are currently supported by three distinct DOE-HQ funding elements: the Environmental Restoration Program, the Hazardous Waste Compliance Technology Program, and the Hazardous Waste Research and Development R and D Program. The Environmental Restoration Program is discussed in the paper, entitled The DOE Defense Program for Environmental Restoration.

39996 The changing arena. Albenesius, E.L. (Savannah River - DuPont, Aiken, SC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Four of the five orders that address waste management within the Department of Energy are being revised. One year ago, an intensive effort began to revise the Radioactive Waste Management Order to a more detailed and prescriptive style. The chapters on management of high-level waste, transuranic-contaminated waste, and low-level waste have all been expanded substantially with particular emphasis on accountability and on the network of other Federal regulations that strengthen the base of the order. In addition, the low-level waste chapter reaches for equivalence with Nuclear Regulatory Commission regulations for commercial waste. A draft of the revised order is in the formal internal review process. The goal for issue of the approved order is May 1988.

39997 U.S. Department of Energy defense waste management program implementation plan. Jordan, E.A. (U.S. Dept. of Energy, Office of Defense Waste and Transportation Management, Washington, DC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Program Implementation Plan describes the Department of Energy's current approach to managing its defense high-level, low-level, and transuranic radioactive waste. It documents implementation of the policies described in the 1983 Defense Waste Management Plan.

39998 Balancing the technical, administrative, and institutional forces in defense waste management. Hindman, T.B. (Office of Defense Waste and Transportation Management, U.S. Dept. of Energy, Washington, DC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Defense radioactive waste results from the Department of Energy's (DOE) national defense and nuclear weapons production activities. In 1983, the President submitted to Congress the Defense Waste Management Plan (DWMP) for defense high-level and transuranic wastes. The Plan proposed a workable approach for the final disposition of these wastes. The Department is still following the path laid out in this Plan. The proper management of this waste requires that technical, administrative, and institutional forces which are often neither well understood nor well documented be properly balanced. This paper clarifies the role these three forces play in the Defense waste management programs and provides examples of their impacts on specific programs.

39999 TRICAM. Gupta, S. (Office of Transportation Systems and Planning, Battelle, Project Management Div., Columbus, OH (US)); Tzemos, S.; Boggs-Mayes, C. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This is the second paper on the subject of the application of optimization techniques to decision making in the Transportation Program of the Office of Civilian Radioactive Waste Management (OCRWM). The first paper described at a conceptual level the optimization approach and its application to decision making. The earlier paper also presented a general description of TRICAM, under development at that time, which would enable the comparison of transportation system alternatives on the basis of the optimal costs and risks achievable under each alternative. TRICAM has since been completed and the present paper is intended to document its features and capabilities at a detailed level.

40000 The low-level waste handling challenge at the Feed Materials Production Center. Harmon, J.E. (Westinghouse Materials Co. of Ohio, Cincinnati, OH (US)); Diehl, D.E.; Gardner, R.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The management of low-level wastes from the production of depleted uranium at the Feed Materials Production Center presents an enormous challenge. The recovery of uranium from materials contaminated with depleted uranium is usually not economical. As a result, large volumes of wastes are generated. The Westinghouse Materials Company of Ohio has established an aggressive waste management program. Simple solutions have been applied to problems in the areas of waste handling and waste minimization. The success of this program has been demonstrated by the reduction of low-level waste inventory at the Feed Materials Production Center.

40001 Operating experience in a radioactive liquid-fed ceramic melter vitrification facility. Holton, L.K. Jr. (Pacific Northwest Lab., Richland, WA (US)); Dierks, R.D.; Goles, R.W.; Katayama, Y.B.; Surma, J.E.; Thomas, N.M. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering

Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Between October 1984 and March 1987, the Pacific Northwest Laboratory (PNL) operated a pilot-scale radioactive liquid-fed ceramic melter (RLFCM) to convert radioactive solutions to a solid vitrified form (borosilicate glass). The facility was operated to test vitrification equipment components in a radioactive environment and to develop design and operating data that can be applied to U.S. Department of Energy (DOE) production-scale operations. The radioactive testing scope of the RLFCM has concentrated on testing vitrification flowsheets that simulate waste stored at West Valley, New York, and on preparing radioactive canisters for a special repository test in the Federal Republic of Germany. During radioactive testing in the RLFCM 38 canisters of glass were produced. This paper summarizes equipment and process experience obtained from the operations of equipment systems for waste feeding, waste vitrification, canister filling, canister handling, and vitrification off-gas treatment.

40002 Update on the Hanford waste vitrification plant technical developments. Scott, J.L. (Westinghouse Hanford Co., Richland, WA (US)); Wolfe, B.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The U.S. Department of Energy (DOE) program to dispose a defense high-level waste is formally described in the Defense Waste Management Plan submitted to Congress in 1983. This plan outlines the strategy of sequencing the disposal efforts at the three DOE sites that have high-level waste: Savannah River, Hanford site, and Idaho. A key element of the Hanford Site waste-management strategy is the construction of a new facility, the Hanford Waste Vitrification Plant (HWVP), to vitrify existing and future liquid high-level waste produced by defense activities at the Hanford Site. An earlier paper presented at Waste Management '86 describes design aspects of the HWVP. This paper presents a brief description of the HWVP Project and describes the progress made by the HWVP Project on key applied technology issues. The HWVP technology approach is to identify key HWVP waste-form qualification and design issues, identify sources of applicable vitrification technology, and maximize the use of existing DOE vitrification technology and design resources. The HWVP issues are resolved through technology exchange, support from other Hanford Site waste-management programs, and a limited HWVP applied technology development effort.

40003 High level waste vitrification at the SRP (DWPF summary). Weisman, A. (Savannah River Lab., Aiken, SC (US)); Papouchado, L.M.; Knight, J.R.; McIntosh, D.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Savannah River Plant has been operating a nuclear fuel cycle since the early 1950's. Fuel and target elements are fabricated and irradiated to produce nuclear materials. After removal from the reactors, the fuel elements are processed to extract the produces, and waste is stored. During the thirty years of operation including evaporation, about 30 million gallons of high level radioactive waste has accumulated. The Defense Waste Processing Facility (DWPF) under construction at Savannah River processes this waste into a borosilicate glass for long-term geologic disposal. The construction of the DWPF is about 70% complete; this paper describes the status of the project, including design demonstrations, with an emphasis on the melter system.

40004 Low-level radioactive waste Prototype License Application Project. Conner, J.E. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)); Case, J.T.; Rogers, V.C.; Eng, R. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper reports the status of the Department of Energy's Prototype License Application Project. The Prototype License Application Project evaluates the licenseability of earth-mounded concrete bunkers and below ground vaults for low-level radioactive waste disposal. Work is progressing with a November 1988 completion anticipated.

40005 Contact-handled (CH) mock waste retrieval demonstration. Kelley, C.R. (Westinghouse Electric Corp., Carlsbad, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper discusses the contact-handled (CH) mock waste retrieval demonstration which was conducted for the state of New Mexico on September 17, 1987. The demonstration met one of the design criterion for the WIPP project and one of the milestones spelled out in the Agreement for the cooperation and consultation between the state of New Mexico and the Department of Energy (DOE). The demonstration documented the ability to safely retrieve CH waste from an in-situ condition approximately 11 years after the initial waste would be emplaced. This paper presents operational aspects that were addressed during the actual conduct of the demonstration. Included are the methods and equipment that were used for the retrieval demonstration. Some of the specific points to be covered are contamination control, equipment operation under special underground conditions, phases of operator training, lighting, package wrapping techniques, and drum retrieval.

40006 Overview of DOE's transuranic waste program. McFadden, M.H. (U.S. Dept. of Energy, Carlsbad, NM (US)); Detamore, J.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The United States Department of Energy (DOE) has assigned to Albuquerque Operations the Defense Transuranic Waste Program (DTWP) responsibility for long-range planning and management for defense transuranic (TRU) waste. The Transuranic Waste Lead Organization (TLO) has divided the Program into seven elements that support its primary goal of ending interim storage and achieving permanent disposal. These elements include waste generation site activities, storage site activities, burial site activities, technology development, transportation, institutional activities and permanent disposal. This paper briefly discusses these seven elements and how they are integrated to provide for successful achievement of the primary goal.

40007 Asphalt solidification of mixed wastes. Mattus, A.J. (Oak Ridge National Lab., Oak Ridge, TN (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Mixed wastes pose a problem to generators since there are no burial sites or treatment facilities currently accepting this waste type. One potential disposal method is treating the waste to render it non-hazardous, and disposing of it in accordance with radioactive waste requirements. A possible means of accomplishing this transformation is solidifying the waste in asphalt (bitumen). Associated Technologies Incorporated, in cooperation with Oak Ridge National Laboratory, solidified in asphalt a surrogate sodium nitrate-based waste, spiked with EPtoxic metals and non-radioactive cesium and strontium. This paper reports the characteristics of the spiked ORNL solution that was solidified as well as the properties of the solidified end product. The waste samples generated underwent EP toxicity testing as well as ANS 16.1 leach testing for 90 days and the results of those tests are presented. Also, a discussion of the criteria for classifying a waste as hazardous are included in order to demonstrate that the waste, once solidified in asphalt, may no longer be considered hazardous.

40008 Studies to determine the fate of radioactive wastes disposed of by underground injection at Oak Ridge National Laboratory. Haase, C.S. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN (US)); VonDamm, K.L.; Stow, S.H.

vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

At Oak Ridge National Laboratory, subsurface injection has been used to dispose of liquid low-level nuclear waste for the past two decades. The process consists of mixing the liquid waste with cement and other additives to form a slurry that is injected under pressure through a cased well into a low-permeability shale at a depth of – 300 m. The slurry spreads from the well along hydraulic fractures and sets to form irregularly shaped grout sheets of up to 200 m in radius. Over 1.8 x 10^7 L of slurry, containing more than 5.5 x 10^{16} Bq of radionuclides (principally ^{90}Sr and ^{137}Cs), have been disposed of since this process was developed in the early 1960s. Under its underground injection control regulations, the state of Tennessee has tentatively assigned a Class V status to the well. In 1986, the U.S. Department of Energy, owner of the facility, decided to close the site. Closure-related site characterization provides a unique opportunity to study the fate of the injected wastes. A series of monitoring wells are in place to measure groundwater chemistries within the injection strata and within overlying and underlying confining units.

40009 Demonstration of remotely operated tru waste size reduction and material handling equipment. Looper, M.G. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC (US)); Charlesworth, D.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Savannah River Laboratory (SRL) is developing remote size reduction and material handling equipment to prepare 238Pu and 239Pu contaminated waste for permanent disposal at the Waste Isolation Pilot Plant (WIPP) in New Mexico. The waste is generated at the Savannah River Plant (SRP) from normal operation and decommissioning activity and is retrievably stored on-site. A Transuranic Waste Facility for preparing, size-reducing, and packaging this waste for disposal is scheduled for completion in 1995. A cold test facility for demonstrating the size reduction and material handling equipment was built, and testing began in January 1987.

40010 Application of microwave energy for solidification of tru waste. Petersen, R.D. (Rockwell International, Rocky Flats Plant, Golden, CO (US)); Johnson, A.J.; Swanson, S.D. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The application of microwave energy for in-container solidification of simulated transuranic contaminated precipitation sludges has been tested. Tests have found that volume reductions of 80% are achievable by the continuous feeding of pre-dried sludge into a waste container while applying microwave energy. An economic evaluation was completed showing that volume and weight reductions of up to 87% are achievable over an immobilization process currently in use on wet sludge.

40011 Product characteristics of TRU waste immobilized in grout. Greenhalgh, W.O. (Westinghouse Hanford Co., Richland, WA (US)); Cash, R.J.; Christie, M.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Laboratory and drum-sized specimens of simulated processed Hanford TRU waste termed shred/grouth were tested for WIPP-WAC compliance for various compositions. Most test compositions were found to meet WIPP criteria. Other waste tests were conducted including 10 CFR-61 and selected 10 CFR-71 tests. A typical shred/grout composition was shown to exhibit excellent performance against WIPP and other waste tests. As a result of the testing, shred/grouth is recommended as an acceptable form for processed Hanford TRU wastes designated for WIPP disposal.

40012 WIPP/SRL in situ testing program. Wicks, G.G. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC (US)); Molecke, M.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The first series of in situ, high-level waste form leaching tests to be conducted in the United States was started on July 22, 1986. This effort, the WIPP Materials Interface Interactions Tests (MIIT), involves the underground test emplacement of almost 1900 (nonradioactive) waste form, metal container, and geologic samples in the bedded salt at the Waste Isolation Pilot Plant (WIPP) facility, near Carlsbad, New Mexico. Samples were supplied from seven countries and are being analyzed by laboratories and universities in the United States, Canada, France, Germany, Belgium, Japan, the United Kingdom, and Sweden. Post test analyses of samples removed after 0.5 and 1 year of testing are in progress. The MIIT data complement other laboratory and international in situ efforts involving underground field testing of Savannah River Laboratory simulated nuclear waste glasses. The MIIT international program is a joint effort conducted and managed by Sandia National Laboratories and Savannah River Laboratory at the WIPP, and is sponsored by the US Department of Energy.

40013 Summary of site-characterization studies conducted from 1983 through 1987 at the Waste Isolation Pilot Plant (WIPP) site, southeastern New Mexico. Lappin, A.R. (Sandia National Labs., Div. 6331, Albuquerque, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Waste Isolation Pilot Plant (WIPP) is being excavated at a depth of approximately 655 m in bedded halites. Site-characterization activities at the WIPP site began in 1976. Characterization activities since 1983 have had the objective of updating the conceptual model for the geologic and hydrologic behavior of the WIPP site and vicinity. This paper discusses aspects of the general conceptual model significant to both site characterization and performance assessment. The geological and hydrologic behavior of the WIPP site and vicinity is transient, and has been transient since at least deposition of the Permian Salado Formation containing the underground workings of the WIPP facility. The Salado Formation deforms regionally in response to gravity, but is very low in permeability, except within approximately two meters of the WIPP facility. The Culebra Dolomite Member of the Rustler Formation dominates the hydrology at the WIPP site. Hydrologic measurements, geologic studies, major-element and minor-element distributions in Culebra fluids, and the results of isotopic studies (stable-isotope, radiocarbon, uranium-disequilibrium, and $^{87}Sr/^{86}Sr$) are consistent with the interpretations that, although the Culebra dominates flow within the Rustler at the WIPP site and Rustler karst is not present, there has been limited vertical fluid movement within the Rustler and between the Rustler and the overlying Dewey Lake Red Beds.

40014 An overview of the WIPP R and D program. Lukow, T.E. (Dept. of Energy, Waste Isolation Pilot Plant, Carlsbad, NM (US)); Daub, V. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Waste Isolation Pilot Plant (WIPP) located in Carlsbad, New Mexico is a Research and Development (R and D) facility established in 1979 by Public Law 96-164 to demonstrate the safe disposal of defense generated TRU-waste in a geologic repository. PL 96-164 defines the WIPP mission as ...a defense activity... for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission. Specifically the WIPP was developed by the DOE to address technical issues concerning the safe disposal of Defense Transuranic (TRU) Wastes in a rock salt underground storage room configuration and to determine WIPP's ability to comply with all regulations applicable for permanent storage of TRU waste in an underground repository. DOE was also directed by Congress to use WIPP as a experimental facility to conduct radioactive waste experiemnts as

well. However, the radioactive waste used for experiments at WIPP must be removed from the site at the end of the experiment.

40015 Operational readiness a key component of WIPP's risk-based management program. Broberg, K. (Waste Isolation Pilot Plant, Carlsbad, NM (US)); Cossell, S.; Campbell, T. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Operations at WIPP include a Risk-Based Management (RBM) program. The goal of this program is to quantify the impact of risk on day-to-day management activities. This paper discusses operational readiness, how WIPP Operational Readiness Reviews serve to coordinate verification of this readiness, and how these reviews fit into WIPP's RBM program.

40016 WIPP. Tillman, J.B. (U.S. Dept. of Energy, WIPP Project, Carlsbad, NM (US)); Hunt, A.E. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Department of Energy (DOE) is constructing the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. This facility first retrievably stores and then permanently disposes of transuranic (TRU) waste generated from defense activities of the United States. This paper describes WIPP 1987 accomplishments and identifies 1988 activity plans in preparation for October 1988 receipt of waste shipments. The WIPP Project is currently on schedule, within budget, and in conformance with technical and institutional baselines.

40017 Demonstration of a performance assessment methodology for nuclear waste isolation in basalt formations. Bonano, E.J. (Sandia National Labs., Albuquerque, NM (US)); Davis, P.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper summarizes the results of the demonstration of a performance assessment methodology developed by Sandia National Laboratories, Albuquerque for the U.S. Nuclear Regulatory Commission for use in the analysis of high-level radioactive waste disposal in deep basalts. Seven scenarios that could affect the performance of a repository in basalts were analyzed. One of these scenarios, normal groundwater flow, was called the base-case scenario. This was used to demonstrate the modeling capabilities in the methodology necessary to assess compliance with the groundwater travel time criterion in 10CFR60 and the Containment Requirements in 40CFR191. The scenario analysis consisted of both scenario screening and consequence modeling. Preliminary analyses of scenarios considering heat released from the waste and the alteration of the hydraulic properties of the rock mass due to loads created by a glacier suggested that these effects would not be significant. The analysis of other scenarios indicated that those changing the flow field in the vicinity of the repository would have an impact on radionuclide discharges, while changes far from the repository may not be significant. The analysis of the base-case scenario was used to show the importance of matrix diffusion as a radionuclide retardation mechanism in fractured media.

40018 Development of a Plutonium-239 Recovery Incinerator. Williams, S. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC (US)); Charlesworth, D.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

A Plutonium-239 Recovery Incinerator is being developed for the Savannah River Plant (SRP) to reduce the volume of solid glovebox waste and to allow recovery of Pu-239 from the waste. The process also allows treatment of some waste materials that are not certifiable for disposal at the Waste Isolation Pilot Plant (WIPP). It consists of two electrically heated combustion chambers (furnace and afterburner) and a dry filtration off-gas system. A unique feature of the process is that it uses pyrohydrolysis to produce an ash that is amenable to Pu recovery through nitric acid/HF dissolution. A series of thermogravimentric (TGA) analyses have been performed to characterize potential incinerator feed materials. A functioning furnace mockup was built and operated to demonstrate electrically-heated pyrohydrolysis operation. A prototype is currently being designed with an expected startup during the third quarter of 1988.

40019 A mechanistic model for leaching from low-level radioactive waste packages. Kempf, C.R. (Brookhaven National Lab., Dept. of Nuclear Energy, Upton, NY (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The development of a waste leaching model to predict radionuclide releases from porous wastes in corrodible outer containers in unsaturated conditions and/or conditions of intermittent water flow is summarized in this paper. Three major processes have been conceptualized as necessarily participating in waste leaching: infiltration of water to the waste package; interaction of this water with the waste; and exit of radionuclide-laden water from the waste package. Through the exit point, the main features of the whole leaching process ware held in common. The departure occurs in two main ways: 1) the method of entrance of the radionuclides to leachant (i.e. part of the waste-water interaction phase outlined earlier); and 2) the mode of exit from waste form/waste package (i.e., the exit of radionuclide-laden water phase). The first branching point, which occurs in relation to 1), leads to either readily soluble species directly entering leachant on contact, or to other processes - mainly expected to be diffusion, dissolution or ion exchange, or some combination thereof.

40020 Investigation of the pitting corrosion of low carbon steel containers. Mughabghab, S.F. (Brookhaven National Lab., Upton, NY (US)); Sullivan, T.M. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The present study was undertaken because the prediction of the degradation rate of low carbon steel contains over long time frames is one of the crucial elements in the development of a source term model for low-level shallow land burial. The principal data base considered is that of the NBS corrosion measurements of ferrous materials buried in the ground for periods of up to 18 years. In this investigation, the maximum penetration in mils, hm, due to pitting corrosion was found to conform closely to the relation $h_m = kt^n$ where it is the exposure time of the sample in years, κ is the pitting parameter in mil/(years)^n, and $n > O$ is a parameter related to the aeration property of the soil. The central objective of the present investigation is the determination of the dependence of the pitting parameters κ and n on the soil properties. The result of a detailed linear correlation analysis of κ on one hand, the pH value and the resistivity of the soil on the other hand revealed that κ is principally influenced by the pH value of the soil. The resistivity of the soil is found to play a minor role.

40021 Salt impact studies at WIPP effects of surface storage of salt on microbial activity. Rodriguez, A.L. (IT Corp., Waste Isolation Pilot Plant, Carlsbad, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Waste Isolation Pilot Plant (WIPP) currently under construction in southeastern New Mexico is a research and development facility to demonstrate the safe disposal of transuranic waste in a deep geological formation (bedded salt). The Ecological Monitoring Program at WIPP is designed to detect and measure changes in the local ecosystem which may be the result of WIPP construction activities. The primary factor which may affect the system prior to waste emplacement is windblown salt from discrete stockpiles. Both vegetation and soil microbial processes should reflect changes in soil chemistry due to salt importation. Control and experimental (potentially affected) plots have been established at the site, and several parameters are measured quarterly in each plot as part of the soil

microbial sampling subprogram. This subprogram was designed to monitor a portion of the biological community which can be affected by changes in the chemical properties at the soil surface.

40022 The evolution of the Waste Isolation Pilot Plant (WIPP) project's public affairs program. Walter, L.H. (Waste Isolation Div., Westinghouse Electric Corp., Waste Isolation Pilot Plant, Carlsbad, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

As a first-of-a-kind facility, the Waste Isolation Pilot Plant (WIPP) presents a unique perspective on the value of designing a public affairs program that grown with and complements a project's evolution from construction to operations. Like the project itself, the public affairs programs progressed through several stages to its present scope. During the construction phase, foundations were laid in the community. Then, in this past year as the project entered a preoperational status, emphasis shifted to broaden the positive image that had been created locally. In this stage, public affairs presented the project's positive elements to the various state agencies, government officials, and federal organizations involved in our country's radioactive waste management program. Most recently, and continuing until receipt of the first shipment of waste in October 1988, an even broader, more aggressive public affairs program is planned.

40023 Public attitudes near a nuclear waste site. Hoffman, W.D. (West Valley Nuclear Services Co., Inc., West Valley, NY (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper discusses results from the 1987 survey taken at the West Valley Demonstration Project where a large nuclear waste cleanup is in progress. Over 1200 people were polled on priorities they give to radioactive waste cleanup, their attitudes toward nuclear energy, and their opinions on the issues of high and low level waste siting. Responses are compared with earlier West Valley data to establish trends in public attitudes on nuclear issues. A demographic analysis describes the population surveyed. The bottom line of the study is to gauge public perception of radioactive waste cleanup, nuclear energy, and waste siting. A comprehensive effort is made to statistically correlate demographic variables with nuclear attitudes.

40024 Characterization of low-level waste from the industrial sector, and near-term projection of waste volumes and types. MacKenzie, D.R. (Dept. of Nuclear Energy, Brookhaven National Lab., Upton, NY (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

A telephone survey of low-level waste generators has been carried out in order to make useful estimates of the volume and nature of the waste which the generators are shipping for disposal when the compacts and states begin operating new disposal facilities. Emphasis of the survey was on the industrial sector, since there has been little information available on characteristics of industrial LLW. Ten large industrial generators shipping to Richland, ten shipping to Barnwell, and two whose wastes had previously been characterized by BNL were contacted. The waste volume shipped by these generators accounted for about two-thirds to three-quarters of the total industrial volume. Results are given in terms of the categories of LLW represented and of the chemical characteristics of the different wastes. Estimates by the respondents of their near-term waste volume projections are presented.

40025 Effects of vegetation and soil-surface cover treatments on the hydrologic behavior of low-level waste trench caps. Lopez, E.A. (Environmental Science Group, HSE-12, Los Alamos National Lab., Los Alamos, NM (US)); Barnes, F.J.; Antonio, E.J. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Preliminary results are presented on a three-year field study at Los Alamos National Laboratory to evaluate the influence of different low-level radioactive waste trench cap designs on water balance under natural precipitation. Erosion plots having two different vegetative covers (shrubs and grasses) and with either gravel-mulched or unmulched soil surrface treatments have been established on three different soil profiles on a decommissioned waste site. Total runoff and soil loss from each plot is measured after each precipitation event. Soil mixture is measured biweekly while plant canopy cover is measured seasonally. Preliminary results from the first year show that the application of a gravel mulch reduced runoff by 73 to 90%. Total soil loss was reduced by 83 to 93% by the mulch treatment.

40026 The importance of scenario development in meeting 40 CFR part 191. Hunter, R.L. (Sandia National Labs., Albuquerque, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Scenario development and screening is a fundamental part of performance assessment, but its importance in satisfying 40 CFR Part 191 (the standard) is sometimes underestimated. The first step in scenario development in support of performance assessment for the standard's containment requirements is to identify a set of potentially disruptive events and processes. This set must be broad enough to allow the identification, as required by the standard, of those processes and events that might affect the disposal system; data can then be collected on the scenarios identified in this step. The standard also requires that releases be estimated for all significant processes and events; thus the final step in scenario development is systematically screening the scenarios, on the basis of their probabilities and consequences, to select those that are important enough to be modeled in detail. In general, a few hundred scenarios for the release of radionuclides from a nuclear-waste repository can be identified, but only a few of these can or should be modeled in detail.

40027 An introduction to technical issues important to geologic repository preclosure safety. Babad, H. (Westinghouse Hanford Co., Richland, WA (US)); Dukelow, J. Jr. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Preclosure safety assessment for construction, operation, caretaking, and decommissioning is required by the U.S. Regulatory Commission (NRC) regulations as part of a license application for nuclear waste repositories. This paper presents a variety of design and safety analysis issues addressed as part of the preclosure safety analysis of nuclear waste repositories. The definition of the issues and suggested approaches to resolving the issues are presented. These technical issues arose during the process of defining site-specific issue resolution strategies related to design and preclosure safety in the Office of Geologic Repositories Issues Hierarchy. These issue resolution strategies are described in the Basalt Waste Project (BWIP) Site Characterization Plan. Participation in the U.S. Department of Energy (DOE) Preclosure Risk Assessment Methodology (PRAM) Working Group has also helped to define the open technical issues.

40028 Evaluation of wastewater treatment systems for the Uranium Mill Tailings Remedial Action Project - Lakeview, Oregon site. Meyer, H.R. (Chem-Nuclear Systems, Inc., 2309 Renard Place SE, Albuquerque, NM (US)); Conroy, K.; Petelka, F.; Leske, D.; Rickey, R. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

During remedial action at the Lakeview, Oregon, Uranium Mill Tailings Remedial Action Project site, unexpectedly large volumes of contaminated water required quick identification and design of a treatment facility capable of meeting Oregon release limits. A laboratory program was prepared and executed to determine the efficiency and cost-effectiveness of several alternative treatment approaches, and an optimum system was selected, designed and deployed.

40029 Biodegradation of ion-exchange media. Bowerman, B.S. (Brookhaven National Lab., Upton, NY (US)); Clinton, J.H.; Cowdery, S.R. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Ion Exchange resin waste from the high flux beam reactor at Brookhaven National Laboratory provided a mixed microbial culture which was used to evaluate the ability of different resin types to support biological activity. The culture of bacteria and fungi grew after the dewatered resin wastes were mixed with water, nutrient slats and a secondary carbon source. The effects of environment factors such as resin chemicals sorbed on the resins and radiation damage were examined. Heavier growths were seen in Amberlite IRN resins subjected to 100 Mrad of gamma irradiation. The presence of organic acids anions (used in dilute chemical decontamination processes) on the resins encouraged heavier microbial growths.

40030 Effects of chemical and gamma irradiation environments on the mechanical properties of high-density polyethylene (HDPE). Soo, P. (Brookhaven National Lab., Upton, NY (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

High-Density polyethylene (HDPE) is currently being used as a high-integrity container material for low-level waste. Because of the need for such containers to maintain their structural integrity for at least 300 years, potential failure, degradation modes must be determined for realistic environmental conditions. These include consideration of mechanical stress, gaseous/liquid environments within an external to the container, and the gamma radiation field. A combination of simple inexpensive tests (stressed U-bend samples) and more sophisticated longer-term creep tests was used to define the ranges of conditions for which mechanical failure/degradation is important. It was found that some simulated contaminants in low-level wastes are detrimental to creep behavior. Gamma irradiation, under some conditions, can also lead to embrittlements of HDPE and cause early failure.

40031 The effect of cure conditions on the stability of cement waste forms after immersion in water. Siskind, B. (Brookhaven National Lab., Dept. of Nuclear Energy, Upton, NY (US)); Adams, J.W.; Clinton, J.H.; Piciulo, P.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The authors investigated the effects of curing conditions on the stability of cement-solidified ion-exchange resins after immersion in water. The test specimens consisted of partially depleted mixed-bed bead resins solidified in one of three vendor-supplied Portland I cement formulations, in a reference cement formulation, or in a gypsum-based binder formulation. They cured samples prepared using each formulation in sealed containers for periods of 7, 14, or 28 days as well as in air or with an accelerated heat cure prior to 90-day immersion in water. Two cement formulations exhibited apparent Portland-cement-like behavior, i.e., compressive strength increased or stabilized with increasing cure time. Two cement formulations exhibited behavior apparently unlike that of Portland cement, i.e. compressive strength decreased with increasing cure time. Such non-Portland-cement-like behavior is correlated with higher waste loadings. The gypsum-based formulation exhibited approximately constant compressive strength with cure time. Accelerated heat cures may not give compressive strengths representative of real-time cures. Some physical deterioration (cracking, spalling) of the waste form occurs during immersion.

40032 Development of site specific radiological decommissioning criteria for a high-level waste processing and vitrification project. Brown, S.H. (Dames and Moore, Golden, CO (US)); Gordon, J.W. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

In 1980, the United States Congress authorized the U.S. Department of Energy (West Valley Demonstration Project Act; PL-96-368) to solidify 2.1 million litres of liquid high-level radioactive waste (HLW) currently stored at the Western New York Nuclear Service Center (approximately 30 miles south of Buffalo, New York) into a form suitable for transport to and disposal in a federal geologic repository. The method chosen to accomplish this task is vitrification in borosilicate glass. These wastes were produced during the period 1966-1972 when facilities at the center were used for the only commercial nuclear fuel reprocessing operation in the U.S. These wastes contain approximately 30 million curies of mixed fission products and transuranic radionuclides and are presently being stored in two underground tanks at the West Valley site. This paper presents the preliminary results of site specific environmental transport and pathway analyses that have been performed to establish radiological decommissioning criteria for final closure of high-level waste processing and treatment facilities.

40033 Brine seepage into the waste isolation pilot plant (WIPP) excavations. Deal, D.E. (IT Corp., Carlsbad, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Although the WIPP underground workings are considered dry, small amounts of brine (on the order of 0.1 to 2 percent by weight) are present. This amount of brine is not unexpected in rocks of marine sedimentary origin and some migrates into the repository in response to pressure gradients, at essentially isothermal conditions. These small quantities of brine have little effect on the day-to-day operations, but are pervasive throughout the repository and may contribute enough moisture over a period of years to affect resaturation and represssurization after sealing and closure. The observations reported here were obtained in the course of the WIPP Brine Sampling and Evaluation Program (BSEP). Over 2900 brine accumulation measurements have been made in over 14km of drifts and associated drill holes. The BSEP Data Collection began in 1984 and many of the brine seeps have been monitored for more than 900 days. Brine occurs as weeps on exposed surfaces and as seeps of brine at various locations, most noticeably in holes drilled from the underground workings. Over 1400 underground drill holes, most 15 meters or less in length, exist at WIPP. Small amounts of gas are usually associated with the brine. Gas bubbles are observed in many of the brine occurrences.

40034 Fitting statistical frequency distributions to baseline environmental monitoring data for the Waste Isolation Pilot Plant. Fischer, N.T. (IT Corp., Waste Isolation Pilot Plant, Carlsbad, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

A preoperational environmental monitoring program has been active at the Waste Isolation Pilot Plant (WIPP) since July 1985 to determine the levels of radioactivity in various environmental media prior to the first receipt of waste. Ideally, statistical frequency distributions based on preoperational data can be found to accurately model the probability of obtaining a particular result during operations, assuming preoperational processes are intact. This paper presents a preliminary evaluation of four families of probability distribution functions (normal, lognormal, Weibull, and gamma) for their relative fit to 96 weeks of preoperational gross alpha and beta activity data from eight low-volume continuous air sampler locations. The results indicate that for gross beta counts, the lognormal gave the best fit to most data sets, with the gamma, normal, and Weibull following in that order. For gross alpha counts, the Weibull gave the best fits overall, with the gamma, normal and lognormal following.

40035 Results and experience gained from the WIPP remote-handled transuranic waste mock retrieval demonstration. Palanca, R. (Westinghouse Electric Corp., Waste Isolation Div., Carlsbad, NM (US)); Stumbaugh, J. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper presents the results and experience gained from the remote-handled transuranic (RHTRU) waste mock retrieval demonstration conducted at the Waste Isolation Pilot Plant (WIPP). The demonstration was carried out as a requirement of the Consultation and Cooperation Agreement between the State of the New Mexico and the Department of Energy (DOE). The highly successfully demonstration was used to document the retrievability of the RH TRU waste form should retrieval ever become necessary. This paper describes major events in the preparation for the demonstration, how the demonstration was conducted, and how it was witnessed and documented. Also detailed are the operational methods utilized to reduce the total time required to complete retrievals over that which was originally estimated. Operator training and administrative actions taken to keep simulated radiation exposures as low as reasonably achievable are also given.

40036 Salt impact studies at WIPP. Cockman, J.S. (IT Corp., Waste Isolation Pilot Plant, Carlsbad, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Waste Isolation Pilot Plant (WIPP) is a research facility operated for the Department of Energy (DOE) to demonstrate the safe disposal of transuranic (TRU) wastes derived from the defense activities of the United States. The facility is located in an area of stabilized sand dunes with the actual waste repository positioned in a deep geologic formation of bedded salt. Prior to waste emplacement, salt is mined to create repository rooms and stock piled on the surface. Windblown salt from the stockpiles may have an impact on adjacent vegetation and soils. Control and experimental plots have been established at the facility to monitor the affects of windblown salt on the surface ecosystem. Vegetation is sampled as part of a series of subprograms to monitor foliar cover, species richness, annual plant density, and community structure.

40037 Behavior of a simulated, metal spent-fuel storage cask under explosive attack. Philbin, J.S. (Sandia National Labs., Albuquerque, NM (US)); Emerson, E.L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper presents experimental data and calculations to define the potential hazard from a hostile attack upon a metal spent-fuel cask utilized for on-site, above-ground storage. A high energy device (HED) was directed at a simulated section (test article) of a large, dry storage cask for on-site storage of 5-yr or older spent fuel. The test article consisted of steel plates, representing the metal storage cask wall, followed by nine compartments containing depleted fuel rod assemblies. The fuel rods were shortened to 381 mm (15 in) and mounted into bundles with the same pitch-to-diameter as a BWR 7x7 rod bundle. The test article configuration was representative of the basket/fuel arrangement found in the cavity of a full-size storage cask. The explosive device caused penetration through five of the nine fuel assembly compartments, producing progressively smaller holes and damage as it proceeded into the test article. The total mass of UO_2 displaced (i.e., removed from the clad/rod geometry) by the penetration was 12.9 kg. Of this total, 2.03 kg of the UO_2 was expelled from the test article to an area defined by a 4.6 m (15 ft) radius from the front of the test article.

40038 Recycle of sodium carbonate solution solves significant low-level waste problems at ICPP. Wheeler, B.R. (Westinghouse Idaho Nuclear Co., Inc., P.O. Box 4000, Idaho Falls, ID (US)); Hogg, G.W. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

A program being conducted at the Idaho Chemical Processing Plant (ICPP) to recycle waste solutions to the extent feasible and resulting recent success in reducing trace iodine release rates to a percolation pond by more than 70% are described. In an attempt to minimize the release of trace quantities of Iodine-129, an intensive sampling and characterization program was initiated several years ago at the ICPP. A consequence of the extensive characterizing program was that (1) an originally planned iodine removal project was not necessary, saving $1.4 million dollars in capital and $290,000 annually in projected operating costs for the original project, and (2) the creation of sodium waste solution was reduced sufficiently that an additional cost avoidance of $60,000 annually is being realized in the waste evaporation, waste calcination, and bin storage programs at ICPP. This experience showed that characterization of specific individual waste streams can identify innovative means to effectively reduce waste disposition costs and simultaneously solve operating problems.

40039 Development of a cement-based grout for immobilization of a low-level waste stream containing sodium sulfate. Sams, T.L. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN (US)); McDaniel, E.W. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The use of cement-based grouts for immobilizing low-level liquid wastes has proven to be an economical and environmentally acceptable means of disposal. Formulation of grouts for such use often requires extensive research and development efforts. This paper discusses one of the methodologies currently being used by engineers at Oak Ridge National Laboratory. This approach uses statistical methods such as extreme vertices design and mixture experimental design to reduce development time and effort.

40040 In Situ Vitrification preliminary results from the first large-scale radioactive test. Buelt, J.L. (Pacific Northwest Lab., Richland, WA (US)); Westsik, J.H. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The first large-scale radioactive test (LSRT) of In Situ Vitrification (ISV) has been completed. In Situ Vitrification is a process whereby joule heating immobilizes contaminated soil in place by converting it to a durable glass and crystalline waste form. The LSRT was conducted at an actual transuranic contaminated soil site on the Department of Energy's Hanford Site. The test had two objectives: 1) determine large-scale processing performance and 2) produce a waste form that can be fully evaluated as a potential technique for the final disposal of transuranic-contaminated soil sites at Hanford. This accomplishment has provided technical data to evaluate the ISV process for its potential in the final disposition of transuranic-contaminated soil sites at Hanford. The LSRT was completed in June 1987 after 295 hours of operation and 460 MWh of electrical energy dissipated to the molten soil. This resulted in a minimum of a 450-t block of vitrified soil extending to a depth of 7.3m (24 ft). The primary contaminants vitrified during the demonstration were Pu and Am transuranics, but also included up to 26,000 ppm fluorides. Preliminary data show that their retention in the vitrified product exceeded predictions meaning that fewer contaminants needed to be removed from the gaseous effluents by the processing equipment. The gaseous effluents were contained and treated throughout the run; that is, no radioactive or hazardous chemical releases were detected.

40041 An overview of waste management systems at the West Valley demonstration project. McIntosh, T.W. (West Valley Nuclear Services Co., Inc., P.O. Box 191, West Valley, NY (US)); Bixby, W.W.; Krauss, J.E.; Leap, D.R. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

In 1980, the United States Congress passed into law the West Valley Demonstration Project Act authorizing the Department of Energy (DOE) to conduct a nuclear waste management project at a former commercial nuclear fuel reprocessing facility located in West Valley, New York. The Project's main objective is to solidify approximately two million litres of high-level radioactive liquid waste into a form suitable for transport to a federal repository for final disposal. The majority of the liquid waste was produced as a by-product of the PUREX extraction process and is stored in an underground

steel tank. A waste characterization program has shown that the neutralized waste has settled into two distinct layers: a clear alkaline liquid (supernatant) layer and a dense precipitate (sludge) layer. The principle radioactive elements in the waste are cesium 137 (supernatant) and strontium 90 (sludge). This paper describes the overall project strategy, the waste management systems, the present project engineering and construction status and the project schedule leading to radioactive operation.

40042 Evaluation of commercially available decontamination chemicals. Shurte, E.A. (DOE Intern, Decontamination Technology, Student, Vanderbilt Univ., Nashville, TN (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The effectiveness of commercially available decontamination solutions was compared with the effectiveness of 10% oxalic acid in controlled lab. tests. Type 304L stainless steel and Inconel 625 specimens were used. Contamination was sludge from Savannah River Plant (SRP) high level waste tanks. Measured amounts of contamination were placed on each specimen. They were then heated to bond the contamination to the surface and cleaned according to the manufacturer's directions. The effectiveness of the produce was determined by monitoring specimens before and after cleaning. Four of the 16 solutions evaluated removed all the contamination from Type 304L stainless steel. Inconel 625 was more difficult to decontaminate. Further tests are planned with the chemicals that were most effective in this test.

40043 PRESTO-II computer code for safety assessment on shallow land disposal of low-level wastes. Uslu, I. (Turkish Atomic Energy Authority, Ankara (TR)); Fields, D.E.; Yalcintas, M.G. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

PRESTO-II (Prediction of Radiation Exposures from Shallow Trench Operations) computer code is used to assess the risk associated with the shallow land disposal of low-level radioactive waste (LLW) in various sites in Turkey. A preliminary simulation using the PRESTO-II computer code has been run for the site in Koteyli-Balikesir and Kozakli-Nevsehir. This example simulation was performed using the same radionuclide data set believed representative of the LLW disposal facility in Barnwell, South Carolina. These simulation results must be generally regarded as estimates based on the assumptions about waste stream composition, disposal methodology, and site geography. Lower consequences are predicted for the Barnwell, South Carolina site and Kozakli-Nevsehire, relative to the Koteyli-Balikesir but this conclusion results largely from the assumption that Koteyli, Turkey site may eventually be used for agricultural use. If the Koteyli, Turkey site were not irrigated, predicted consequences for this site could be considerably lessened. This presentation summarizes the results of preliminary simulations which have been performed of release and transport of radionuclides from a proposed low-level radioactive waste disposal sites in Turkey.

40044 Prediction of the migration of radionuclides to the boundary of a shallow land burial trench. Sullivan, T.M. (Brookhaven National Lab., Upton, NY (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

A general model which predicts the source term, radionuclide release rate, as a function of water flow, container degradation rate, waste form leach rate, and radionuclide migration rate from a low-level waste shallow land burial trench is being developed. This paper discusses modeling radionuclide migration, one component of the source term. Simulations of radionuclide transport from a generic shallow land burial trench have been performed for a range of water flow rates, dispersivity values, and distribution coefficients. For the modeling assumptions used and the range of parameters tested, the water flow rate plays the major role in redistributing radionuclides within the trench, except in the case of extremely high dispersion. Dispersion was always found to play a significant role in determining transport. This was particularly apparent upstream from the source. Sorption decreased the magnitude of the radionuclide concentration and had the apparent effect of reducing the velocity with which the radionuclides were transported. Diffusion was found to be unimportant in determining radionuclide transport.

40045 Recent developments in technology for recovery/purification of selected byproducts. Jensen, G.A. (Pacific Northwest Lab. (US)); Bray, L.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

For over three decades, U.S. interest in recovery, purification, and application of selected nuclear byproducts (e.g., ^{137}Cs, ^{90}Sr, ^{85}Kr, ^{241}Am, ^{147}Pm, etc.) has remained at a high level. Such interest in byproduct separation and utilization has been sustained even though no irradiated commercial light water reactor fuel, a prime source of such byproducts, has been reprocessed in the U.S. since 1972. This paper briefly reviews and summarizes some recent work at several U.S. Department of Energy (DOE) sites concerning recovery and purification of ^{153}Gd, ^{241}Am, noble metals, and certain other potentially useful and valuable radioactive byproducts. Gadolinium 153 ($t_{1/2}$ = 242d, an activation product) is finding increasing use in the early detection and tracking of osteoporosis. (Osteoporosis is a crippling brittle-bone disease that affects 20 million Americans, mostly women over the age of 45.) Recently, curie amounts of ^{153}Gd have been produced in the Fast Flux Text Facility at the DOE Hanford site by the following simplified nuclear processes. To recover purified ^{153}Gd, irradiated Eu_2O_3 targets were dissolved in acid, and Eu(III) reduced to Eu(II) in a Jones Reductor. Subsequently, Eu(II) sulfate was precipitated to effect a separation of gross amounts of target material from ^{153}Gd.

40046 Recovery of krypton-85 from dissolver off-gas streams. Law, J.P. (Westinghouse Idaho Nuclear Co., Inc., Idaho National Engineering Lab., Idaho Falls, ID (US)); Lamb, K.M. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Rare Gas Plant at the Idaho Chemical Processing Plant Recovers fission product krypton and xenon from dissolver off gas streams. Recently the system was upgraded to allow processing of hydrogen rich dissolver off-gas streams. A trickle bed hydrogen recombiner was installed and tested. The Rare Gas Plant can now safely process gas streams containing up to 80% hydrogen.

40047 Strategy planning for the long-term management of ICPP high-level radioactive waste. Knecht, D.A. (Westinghouse Idaho Nuclear Co., Inc., P.O. Box 4000, Idaho Falls, ID (US)); Berreth, J.R. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Three alternative strategies for the long-term management of Idaho Chemical Processing Plant HLW are being evaluated and include: 1) disposal of all HLW in a geologic repository, 2) disposal of all HLW in a near-surface facility onsite, or 3) disposal of newly generated HLW in a repository and stored calcined waste on site. Both onsite and offsite disposal are being considered at this time in order to fully evaluate all potential options. This paper presents a plan for research and development for the long-term management of ICPP HLW which provides sufficient information to recommend a reference strategy and process. The reference process serves as the basis for process verification tests and environmental documentation work starting in FY 1993. Full-scale implementation of a process and final disposal of ICPP HLW is projected to start in FY 2011.

40048 West valley glass product qualification durability studies. Reimus, M.A.H. (Pacific Northwest Lab., Richland, WA (US)); Piepel, G.F.; Mellinger, G.B. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium

on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Pacific Northwest Laboratory is examining the effects of composition, ferrous/ferric ratio (redox state), heat treatment, and groundwater on the chemical durability of a glass proposed for solidification of West Valley nuclear waste. Several experiments have been conducted, and preliminary results are given in this paper. The results of the experiments conducted to date indicate that waste glass is more durable in groundwater than in deionized water; also, durability is affected by isothermal and simulated canister cooling heat treatments. However, the durability of the waste glass is not strongly affected by the variation of glass redox state. Linear mixture models were fitted to the glass compositional variation data and validated. These models may be used to predict the effects of varying specific components on the reference glass durability within the defined composition region.

40049 Modeling the flow of water in and around shallow burial trenches. Suen, C.J. (Brookhaven National Lab., Upton, NY (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Water flow through a generic low-level waste burial trench has been modeled for a vertical cross-section perpendicular to the longitudinal axis of an elongated trench, using the finite element code, FEMWATER, in two-dimensional vertical mode. The grid consists of 513 nodes and 468 variable-size quadrilateral elements, and the simulation domain is about 56m (H) x 34m (V). The trench, which is situated in the unsaturated zone, measures approximately 28m wide and 10m deep in cross-section, and is composed of three types of soil a high-conductivity gravel cap on top, a low-conductivity clay layer beneath it, and backfill soil in the waste burial region. The rest of the domain is made up of undisturbed soil. Different cases have been simulated by varying boundary conditions, geometry and hydraulic properties. These results are used in radionuclide transport calculations to determine the source term. In addition, numerical experiments provide valuable information in trench design, such as, the geometry of the moisture barrier. Results from these experiments indicate that a moderate extension (8m) of the clay layer beyond the sides of the trench can significantly reduce the net water flow (by 42%). They also show that sparsely distributed waste packages have minimal effect on the net flow through the trench.

40050 Savannah River Plant Separations Department mixed waste program. Wierzbicki, W.M. (E.I. du Pont de Nemours and Co., Savannah River Plant, Aiken, SC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Department of Energy's (DOE) Savannah River Plant (SRP) generates radioactive and mixed waste as a result of the manufacture of nuclear material for the national defense program. On May 1, 1987, DOE published a ruling stating that the hazardous component of mixed waste would be regulated by the EPA or state agencies, effective June 1, 1987. The radioactive portion of the mixed waste and all nonhazardous radioactive wastes would continue to be regulated by DOE under the Atomic Energy Act. The Separations Department is the largest generator of solid radioactive waste at the Savannah River Plant. Over the last three years, the Separations Department has developed and implemented a program to characterize candidate mixed-waste streams. The program consisted of facility personnel interviews, a waste-generation characterization program and waste testing to determine whether a particular waste form was hazardous. This program allowed the department to assess the magnitude of the impact of proposed mixed-waste regulations.

40051 Retrofit design of remotely removable decontamination spray nozzles for the new waste calcining facility at the Idaho National Engineering Laboratory. Gay, J.A. (Westinghouse Idaho Nuclear Co., Inc., Idaho National Engineering Lab., Idaho Falls, ID (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

High level radioactive liquid waste is converted to a solid form at the Idaho Chemical Processing Plant (ICPP). The conversion is done by a fluidized bed combustion process in the calciner vessel. The interior decontamination system for the calciner vessel uses a common header bolted to four decontamination nozzles around the upper head. The retrofit was required to eliminate hands-on maintenance and difficulty in nozzle removal because of nozzle plugging. The retrofit design for this project demonstrates the solution of problems associated with thermal phenomena, structural supports, seismic requirements, remote handling and installations into extremely restricted spaces.

40052 Quality assurance and maintenance of waste management computer software. Harlan, C.P. (Waste Management Systems Div. 6416, Sandia National Labs., Albuquerque, NM (US)); Wilkinson, G.F. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The U.S. Nuclear Regulatory Commission (NRC) has the responsibility of licensing sites for future disposal of commercial high-level radioactive waste. Sandia National Laboratories is assisting the NRC in this effort by developing and demonstrating performance assessment methodologies for evaluating high-level radioactive waste repositories in deep geologic formations. These methodologies include the development and application of computer programs. A computer software maintenance and quality assurance plan has been developed as a part of this effort. The plan and its implementation at Sandia are described in this paper.

40053 Probabilistic assessment of radiological impacts from transuranics in waste at the Savannah River Plant. Cohen, J. (Science Applications International Corp., Pleasanton, CA (US)); Smith, C.F.; Cook, J.R.; King, C.M. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The U.S. Department of Energy has conducted a comprehensive program at its Savannah River Plant (SRP) to assess environmental impacts from waste processing and disposal operations to assure compliance with provisions of the National Environmental Policy Act (DOE, 1987). This program included evaluation of both radioactive and nonradioactive (hazardous) waste disposal sites. As part of the program this study addressed the effect on performance assessments of transuranic (TRU) nuclides due to the natural variability of properties and parameters used in modeling studies. As a first step, a comprehensive review was conducted on sources and TRU content of all radioactive wastes in storage and in disposal sites at SRP. A literature review was also performed to compile an updated data base on parameters affecting potential radiological dose impacts from TRU radionuclides in waste. Of particular interest were the recent changes in dosimetric factors for plutonium, neptunium, and americium based upon ICRP-30 and other evaluations.

0530 Environmental Aspects

Refer also to citation(s) 39933, 39934, 39947, 39948, 39949, 39950, 39951, 39952, 39957, 39962, 39974, 39977, 39978, 39979, 39980, 39981, 39986, 39987, 39988, 39992, 39994, 39995, 40000, 40008, 40013, 40014, 40019, 40021, 40027, 40030, 40036, 40038, 40040, 40049, 40053, 40058, 40074, 40087, 40255, 40258, 40856, 40871

40054 (INIS-mf–11491) **Six-monthly report on surveillance of environmental monitoring in Alligator Rivers Region for the period 1 April-30 September 1988.** Northern Territory Dept. of Mines and Energy, Darwin (Australia). 1988. 51p. Order Number DE89633088/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Report no. sixteen.

This report outlines the activities of Northern Territory Government authorities (Department of Mines and Energy (DME)), Conservation

Commission and Department of Health and Community Services (DHCS) in meeting their responsibilities for surveillance of environmental monitoring in the Alligator Rivers Region for the period 1 April to 30 September 1988. The responsibility for DME activities derives principally from the Mining Act, the Mines Safety Control Act, the Control of Waters Act and the Uranium Mining (Environment Control) Act, referred to in this report as the UMEC Act. The Land Conservation Unit (LCU) of the Conservation Commission and the Occupational and Environmental Health Branch of DHCS, furnish technical advice to the Alligator Rivers Region Unit of DME, which then collates the data for Authorizations, approvals and compliance reports. The responsibilities of the Conservation Commission derive from the Soil Conservation and Land Utilization Act. DHCS activities derive from, in addition to the relevant Mines Acts, the Silicosis and Tuberculosis (Mine Workers and Prospectors) Act, Radiation (Safety Control) Act and the Public Health Act.

0540 Health and Safety

Refer also to citation(s) 39911, 39932, 39933, 39934, 39937, 39987, 39992, 40007, 40008, 40014, 40015, 40026, 40027, 40028, 40032, 40037, 40038, 40040, 40043, 40044, 40053, 40089, 40923, 41015

40055 (ANL/ES–160) **A manual for implementing residual radioactive material guidelines.** Gilbert, T.L.; Yu, C.; Yuan, Y.C.; Zielen, A.J.; Jusko, M.J.; Wallo, A. III. Argonne National Lab., IL (USA). Jun 1989. 203p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. (DOE/CH–8901). Order Number DE89014333/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

A supplement to US Department of Energy guidelines for residual radioactive material at Formerly Utilized Sites Remedial Action Program and Surplus Facilities Management Program sites.

This manual presents information for implementing US Department of Energy (DOE) guidelines for residual radioactive material at sites identified by the Formerly Utilized Sites Remedial Action Program (FUSRAP) and the Surplus Facilities Management Program (SFMP). It describes the analysis and models used to derive site-specific guidelines for allowable residual concentrations of radionuclides in soil and the design and use of the RESRAD computer code for calculating guideline values. It also describes procedures for implementing DOE policy for reducing residual radioactivity to levels that are as low as reasonably achievable. 36 refs., 16 figs, 22 tabs.

40056 (CONF-890854–3) **Department of Energy support to other federal agencies: Experiences with the Installation Restoration Program.** Franco, P.J. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From 11. annual DOE low level waste management conference; Pittsburgh, PA (USA); 22-24 Aug 1989. Order Number DE89014067/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Hazardous Waste Remedial Actions Program (HAZWRAP), in addition to its role as the focus for hazardous waste management for the Department of Energy Defense Programs, also provides technical support to other federal agencies. HAZWRAP currently manages over 130 projects in support of the Department of Defense (DOD) Installation Restoration Program and for mitigating hazards to public health and the environment. This paper related the history of this involvement, lessons learned during the relationship, and initiatives that are being implemented to facilitate response to regulatory requirements. 12 tabs.

40057 (CONF-890854–4) **Program optimization system.** Green, J.W.; Petty, J.L.; Cotton, T.A. Oak Ridge National Lab., TN (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From 11. annual DOE low level waste management conference; Pittsburgh, PA (USA); 22-24 Aug 1989. Order Number DE89014079/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Program Optimization System (POS) constitutes a structured approach intended to help the Department of Energy (DOE) decide how to make the most effective use of funds for cleaning up hazardous waste sites at national defense nuclear facilities. It is being used in developing the budget for the Environmental Restoration (ER) Remedial Actions (RA) Program directed by DOE's Hazardous Waste and Remedial Actions Division. The current ER budget is $350 million and the long-term cost of the ER Program is estimated in the tens of billions of dollars. POS provides a quantitative measure of value of possible ER field office budget levels, and shows how any total budget can be allocated among facilities to optimize that value. It is intended to ensure that the allocation of ER funds among facilities and regions of the country is technically defensible and even-handed, and perceived to be so by the affected parties and their elected representatives who must approve the annual budgets for the Program.

40058 (DOE/NE/44139–54) **Lessons learned at West Valley during facility decontamination for re-use (1982–1988).** Tundo, D.; Gessner, R.F.; Lawrence, R.E. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Nov 1988. 77p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89009017/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The primary mission of the West Valley Demonstration Project (WVDP) is to solidify a large volume of high-level liquid waste (2.3 million liters – 600,000 gallons) produced during reprocessing plant operations and stored in underground tanks. This is to be accomplished through the maximum use of existing facilities. This required a significant effort to remove existing equipment and to decontaminate areas for installation of liquid and cement processing systems in a safe environment while maintaining exposure to workers as low as reasonably achievable. The reprocessing plant occupied a building of about 33,000 m^2 (350,000 ft^2). When the WVDP was initiated, approximately 6 percent of the plant area was in a non-contaminated condition where personnel could function without protective clothing or radiological controls. From 1982 to 1988, an additional 64 percent of the plant was cleaned up and much of this converted to low- and high-level waste processing areas. The high-level liquid and resulting low-level liquids are now being treated in these areas using an Integrated Radwaste Treatment System (IRTS). The Project has now focused attention on installation, qualification and operation of a vitrification system which will convert the remaining high-level waste into borosilicate glass logs. The stabilized waste will be sent to a Federal Repository for long-term storage. From 1982 to 1988, about 70 technical reports were dealing with specific tasks and cleanup efforts. This report provides an overview of the decontamination and decommissioning work done in that period. The report emphasizes lessons learned during that effort. Significant advances were made in: remote and contact decontamination technology; personnel protection and training; planning and procedures; and radiological controls. 62 refs., 35 figs., 5 tabs.

40059 (INIS-mf–11483) **Abstracts of 21. International Symposium Radiation Protection Physics.** Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. 19p. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

45 papers are presented as titles with abstracts which are processed individually for the INIS data base. They deal with general aspects of radiation protection physics, chiefly problems of radiation detection and measuring techniques in radiation protection.

40060 (INIS-mf–11502) **Israeli Health Physics Society Annual Meeting 1988. Program and abstracts of lectures.** Israel Health Physics Society (Israel). 1988. 88p. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The volume contains 20 abstracts of lectures covering topics such as radioactivity in food, the indoor radon problem, optimization of medical exposure, public health, alara and the various relevant radiation protection measures such as emergency planning and preparedness. Also, this is the first time for our society to include the issue of protection from harmful effects of non-ionizing radiations

(NIR) emerging from their growing use in science, medicine, industry and agriculture. At last, the state of radiation protection in Israel is also reviewed.

40061 (INIS-mf–11502, pp. 58-61) **Impact of the ALARA concept on the shielding calculation policies of the Israel Health Ministry.** Ne'eman, E.; Brenner, S.; Faermann, S. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40062 (INIS-mf–11502, pp. 76-82) **Fetus protection in the treatment of pregnant females using 8 Mev protons.** Mandelzweig, Y. (Rambam Medical Center, Haifa (Israel). Dept. of Oncology); Omari, A.; Freedman, D.J. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40063 (ORNL/TM–10971, pp. 117-125) **Analysis of particulate contamination from a PWR.** Hodgson, L.M. (Arkansas Tech Univ., Russellville (USA)); Cypret, O.W.; Culp, R.R. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

Within the last few years several nuclear power plants have reported what the Nuclear Regulatory Commission has referred to as excessive skin exposures as a result of contamination from small, discrete particles of radioactive material. The sources of contamination have been traced to fuel cladding failures, primary system leaks, and activated foreign matter. Once these particles, often called fleas or hot particles, have been disseminated throughout a power plant, they are difficult to detect and control. In this study, several samples of particulate contamination found at two pressurized water reactors on personnel or in controlled access areas were closely examined. If the sample contained a single particle, it was isolated, micro-photographed, and analyzed for gamma and x-ray emission. Some of the particles were further examined using a scanning electron microscope and assayed with x-ray fluorescence. The computer code Quince was used to estimate possible skin doses from such particles.

40064 (UCID–21397) **Analysis of postulated accidents at the proposed decontamination and waste treatment facility at the Lawrence Livermore National Laboratory.** Salazar, R. (ed.). Lawrence Livermore National Lab., CA (USA); Radian Corp., Sacramento, CA (USA). Apr 1988. 285p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015710/JAW. Available from NTIS, PC A13/MF A01 - OSTI.

Accidents that might occur during the handling, treatment, or storage of radioactive and chemically hazardous wastes are discussed and analyzed in this report. The models and assumptions used in the analysis for determining the amount of radioactivity or hazardous material released to the environment and the extent of exposure to facility workers and the public are presented. No high hazard areas were found to exist at DWTF. Only the decontamination building and the liquid waste receiving/feed tank area of the incinerator building have been determined to be moderate hazard facilities. All other areas at DWTF are classified as low hazard. The seismic design of the storage building, a low hazard facility, was upgraded to moderate hazard to further ensure its structural integrity during a design basis earthquake (DBE). In evaluating hypothetical accidents, conservative assumptions have been made. Conservative, as used in this chapter, means that the consequences resulting from the postulated accidents are overestimated rather than underestimated. 10 tabs.

40065 (UCRL–21187) **Self-potential investigation, Nevada Test Site, Mercury, Nevada.** Corwin, R.F. Lawrence Livermore National Lab., CA (USA); Corwin (Robert F.), El Cerrito, CA (USA). 19 Jan 1989. 100p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015780/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

This report describes results of a self-potential (SP) investigation conducted at the Nevada Test Site (NTS), Mercury, Nevada in August and September, 1988. The purpose of the investigation was to determine whether significant SP anomalies could be detected at previous underground nuclear test sites, and to examine possible physical mechanisms for any such anomalies. Also, repeated surveys were conducted immediately preceding and following the test at site U4au to determine whether SP variations could be related to the event. Sites at which SP measurements were taken include U4au, U3mf, U20at, U2ge, U3mh, U20ar, and U10cc. Tabulations of measured and smoothed field data, along with plots of the measured and smoothed data, are included in a previous report. Site characteristics are summarized. This report begins with descriptions of SP equipment, field procedures, and data reduction techniques; and a brief general discussion of factors affecting SP data quality. The following sections present descriptions of the survey results; discussion of the results in terms of data accuracy and reproducibility; and analysis of possible origins and mechanisms for observed anomalous SP variations. 18 refs.

40066 **Perceived knowledge and perceived risk.** Williams, R.G. (Argonne National Lab. (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Much discussion in the area of radioactive waste management has centered on the topic of siting waste facilities in the face of public opposition. Waste managers frequently believe that the public perceives risks associated with radioactive waste as much higher than objective risk. Previous research on this topic confirms that waste managers and the public view the risks differently. The scientific literature in this area has been focused on factors that shape risk perception such as how risk perception varies by group and associations among different types of perceived risk. Research in the area of natural hazards and emergency response has focused on how the public obtains information and how that information is interpreted. In addition, much attention has been given to public involvement and public information programs. Critical to each of these research areas is the role of perception of how informed an individual is on a given risk versus how the individual rates a given risk. This paper seeks to do three things: Look at perception of health risk of radioactive waste in the context of other things related to nuclear technology and radioactivity; Investigate the relationship between perceived knowledge and perceived risk; and Determine social and psychological consequences of perceived risk.

40067 **Supercompaction and repackaging facility for Rocky Flats Plant transuranic waste.** Barthel, J.M. (Rockwell International, Rocky Flats Plant, Golden, CO (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Supercompaction and Repackaging Facility (SaRF) for processing Rocky Flats Plant (RFP) generated transuranic (TRU) waste was conceptualized and has received funding of $1.9 million. The SaRF is scheduled for completion in September, 1989, and eliminates a labor intensive manual repackaging effort. The semi-automated, glovebox-contained SaRF is being designed to process 63,500 cubic feet of TRU waste annually for disposal at the Waste Isolation Pilot Plant (WIPP). SaRF processing sequence is waste enters the process through an airlock or drum dump and the combustible waste is precompacted, drums are pierced to allow air to escape during supercompaction, and the drum is supercompacted and transferred to a load out station for final packaging into a 55 gallon drum. Preliminary evaluations indicate an average 5 to 1 volume reduction, 2 to 1 increased processing rate and 50% reduction in manpower. The SaRF produces a significant annual savings in

labor, material, shipping, and burial costs over the projected 15 year life, and also improves operator safety, reduces personnel exposure, and improves the quality of the waste product.

40068 Progress and problems in the Formerly Utilized Sites Remedial Action Program and Surplus Facilities Management Program. Fiore, J.J. (Div. of Facility and Site Decommissioning Projects, U.S. Dept. of Energy, Washington, DC (US)); Turi, G.P. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established in 1974 to identify, evaluate, and as appropriate, conduct remedial actions at sites used in the early years of nuclear energy development by the Manhattan Engineer District and the Atomic Energy Commission (AEC). This program currently has 29 sites and is evaluating 350 other sites for possible inclusion in the program. Another remedial action program in the Department of Energy's (DOE) Division of Facility and Site Decommissioning Projects is the Surplus Facilities Management Program (SFMP). The SFMP involves the safe management, decontamination and disposal of surplus DOE contaminated facilities which were not related to defense activities. There are currently 33 projects at 15 different sites in the program. These two programs have made steady progress over the last 10 or so years in cleaning up sites so that they can be reused or released for unrestricted use. Work has been completed at 8 of the FUSRAP sites and three of the SFMP sites.

40069 Technical measurements support to DOE remedial action programs. Duray, J.R. (Technical Measurements Center, UNC Geotech, Grand Junction, CO (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Technical Measurements Center (TMC) at the Department of Energy (DOE) Grand Junction Projects Office provides a technical support to DOE remedial action programs. Selected results from field and laboratory studies are presented under three categories: calibration facilities and reference materials, evaluation of instruments and measurement methods, and development of instruments and measurement methods.

40070 Ten years of state evaluation of a nuclear waste repository. Neill, R.H. (Environmental Evaluation Group, State of New Mexico, P.O. Box 968, Santa Fe, NM (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Environmental Evaluation Group (EGG), was established in 1978 to independently evaluate the Waste Isolation Pilot Plant (WIPP) project for the State of New Mexico in order to protect the public health and safety and ensure that there is minimal environmental degradation from the project. By concentrating on objective technical evaluation, the EEG has been able to improve the location, design, operations and safety of the project. The evaluation has consisted of independent analyses of scientific data on site characterization, breach scenario modeling, transportation risks and safety, design parameters, operational risks and safety, waste certification, and mining. The U.S. Department of Energy (DOE) has accepted EEG's suggestions on site relocation, transportation cask redesign, limitations on the kind of waste allowed at WIPP, waste certification procedures, additional site characterization, compliance with regulatory standards, operational procedures, and radiological monitoring EEG's work has also helped in providing a proper perspective and sound foundation to the sometimes emotional debate on actual or perceived risks from a highly visible project. It has thus been possible to resolve contentious issues based on scientific investigations and analyses.

40071 Management of remote-handled defense transuranic wastes. Ebra, M.A. (US DOE, WIPP Project Office, Carlsbad, NM (US)); Pierce, G.D.; Carson, P.H. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Transuranic (TRU) wastes generated by defense-related activities are scheduled for emplacement at the Waste Isolation Pilot Plant (WIPP) in New Mexico beginning in October 1988. After five years of operation as a research and development facility, the WIPP may be designated as a permanent repository for these wastes, if it has been demonstrated that this deep, geologically stable formation is a safe disposal option. Defense TRU wastes are currently stored at various Department of Energy (DOE) sites across the nation. Approximately 2% by volume of currently stored TRU wastes are defined, on the basis of dose rates, as remote-handled (RH). RH wastes continue to be generated at various locations operated by DOE contractors. They require special handling and processing prior to and during emplacement in the WIPP. This paper describes the strategy for managing defense RH TRU wastes.

40072 Progress on the UMTRA project. Little, C.A. (Health and Safety Research Div., Oak Ridge National Lab., Grand Junction, CO (US)); Espegren, M.L.; Berven, B.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Oak Ridge National Laboratory serves as the Inclusion Survey Contractor (ISC) for the Department of Energy's Uranium Mill Tailings Remedial Action Project (UMTRAP). The role of the ISC is to assess whether or not each of the estimated 10,000-plus vicinity properties associated with UMTRAP is contaminated in excess of applicable standards. To date, the ISC has made recommendations on more than 8500 properties. This paper describes the flow of information through the inclusion process, the role of the ISC, and the inclusion progress to date.

40073 Public concerns about RAM transport-communicating engineering data on risk. McClure, J.D. (Sandia National Labs., Albuquerque, NM (US)); Luna, R.E.; Falci, F.P., Jr. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper presents information concerning the safety of transporting radioactive materials (RAM). This evaluation is supported by an examination of data for actual accidents and incidents that have occurred with RAM transport, a study of the regulatory test procedures used to certify RAM packagings and the comparison of RAM transport with that of other hazardous materials. A number of studies are summarized that show that RAM transportation has been a low risk operation for approximately four decades. Where appropriate, RAM transport statistics are compared with the statistics of other hazardous materials. This engineering information can be used by federal, state, and local officials and public interest groups to assess the relative risk of RAM transportation on a national scale and in their local jurisdictions. The organization of engineering data in an orderly and logical fashion and the presentation of this data to government agencies and members of the public can be used in an attempt to allay fears about the safety of RAM transportation.

40074 Characterization and remedial planning for non-radiological toxicants at UMTRA project sites. Reith, C.C. (Jacobs Engineering Group, Albuquerque, NM (US)); Gonzales, D.E.; Millard, J.B.; Matthews, M.L.; Richey, R.H.; Meyer, H.R.; Daily, M.C.; Till, J.E. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The congressional mandate for the Uranium Mill Tailings Remedial Action (UMTRA) Project is to clean up 24 inactive uranium processing facilities around the United States. Remedial actions are performed as necessary to meet standards established by the Environmental Protection Agency (EPA) for levels of Ra-226 in soil. However, potentially hazardous non-radioactive materials have been encountered at a number of UMTRA Project sites, sometimes requiring action beyond that necessary to meet the EPA standards. Foremost among these non-radiological toxicants (NRTs) are metals

and metalloids such as arsenic, molybdenum, selenium, and vanadium: elements that are closely associated with the tailings matrix. In most cases, there are no clear regulatory guidelines or standards to dictate cleanup levels for these substances. A multidisciplinary task force was organized to manage the handling of NRTs at UMTRA Project sites. It was decided that a general procedure was needed to: (1) characterize NRTs at each site, (2) establish site-specific guidelines for cleaning up these substances to a safe level, and (3) identify appropriate remedial actions.

40075 Remedial action progress by the U.S. Department of Energy in New Jersey. Kannard, J.R. (Bechtel National, Inc., Oak Ridge, TN (US)); Atkin, R.G. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The U.S. Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program is responsible for identifying, evaluating, and decontaminating sites used during the Manhattan Engineer District's project that has resulted in residual radioactive contamination at 29 sites in 12 states. New Jersey contains five (or 17 percent) of these sites, all in differing stages of completing remedial action. Two of these sites have not been included in recent program activities. This paper, therefore, focuses on the three active sites and discuss the contrasts in the attitudes of the public and local governments, the quantities of contaminated materials, and the mechanisms by which the contaminants have migrated to vicinity properties. Additionally, several factors affecting the planning and completion of the program, i.e., lack of a permanent disposal site and the Environmental Protection Agency's role, are presented.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 39911, 39933, 39999, 40000, 40005, 40038, 40043, 40050, 40053, 40068, 40069, 40072, 40201, 40923

40076 (DP-MS–89-14) **Development of an active well coincidence counter for U-Al billet assay.** Griffin, J.C.; Selden, E.R. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–34: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89014142/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Savannah River Site (SRS) has completed an experimental evaluation of the application of an active well (neutron) coincidence counter (AWCC) to the assay of ^{235}U in U-Al coextrusion billets of the Savannah River Site fuel fabrication area. Using U-Al coextrusion core standards for the experimental measurements, the AWCC was tested in several different source/sample configurations. As a result of this work, a new configuration was identified for billet assay. This configuration, using a moderated AmLi source placed in the central hole of the billet, yielded a two-standard-deviation precision of 0.6–1.0% for a twenty-minute assay. This precision is a factor of 2–3 better than that obtained from the operation of the AWCC in the standard configuration, i.e., with the interrogation sources located above and below the billet. A dedicated Billet AWCC, using the new center-source configuration and custom-built to accommodate coextrusion billets, is being acquired for use in the fuel fabrication area of SRS. This paper will present details of the experimental work, as well as a description of the resulting AWCC design. 3 refs., 6 figs., 4 tabs.

40077 (EUR–11624) **Image processing system for videotape review.** Bettendroffer, E. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 12p. Available from NTIS (US Sales Only), PC A03/MF A01.

In a nuclear plant, the areas in which fissile materials are stored or handled, have to be monitored continuously. One method of surveillance is to record pictures of TV cameras with determined time intervals on special video recorders. The 'time lapse' recorded tape is played back at normal speed and an inspector checks visually the pictures. This method requires much manpower and an automated method would be useful. The present report describes an automatic reviewing method based on an image processing system; the system detects scene changes in the picture sequence and stores the reduced data set on a separate video tape. The resulting reduction of reviewing time by inspector is important for surveillance data with few movements.

40078 (FEI–1915) **Modified vacuum X-ray goniometer.** Zakharov, O.P.; Seredkin, Yu.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 9p. (In Russian). Order Number DE89633832/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Consideration is given to modified structural units of vacuum X-ray goniometer: input ioindow of sample chamber and the unit of diffraction angle measuring. Accuracy of automatic detector set to assigned angular position increased up to ± 5 secs. of arc. New units were installed: the unit of sample rotation around the vertical axis with measuring and automatic set to assigned position with mentioned above accuracy and the unit of primary beam monochromatization with the use of differential absorption filters; this, in some cases, provides for higher intensity as compared to the crystal monochromator. 3 refs.; 2 figs.

40079 (LA-UR–89-1559) **Modeling risk assessment applications with LAVA [Los Alamos Vulnerability/Risk Assessment].** Smith, S.T. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890889–2: 5. annual symposium on technical displays on physical and electronic security, Philadelphia, PA (USA), 15-17 Aug 1989). Order Number DE89013209/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

LAVA (the Los Alamos Vulnerability/Risk Assessment system) is a three-part systematic approach to vulnerability and risk assessment that can be used to model a variety of application systems such as physical or operational security systems, communications security systems, information security systems, and others. Using LAVA, we build knowledge-based expert systems to assess risks in application systems comprising a subject system and a safeguards system. The methodology provides a framework for creating a variety of applications systems upon which the general software engine operates. All application-specific information is supplied as data and requires no code changes in the general software engine. This paper discusses the ingredients for creating a LAVA application system. 14 refs.

40080 (LA-UR–89-2214) **Inventory confirmation measurement at Los Alamos National Laboratory.** Hsue, F.; Marshall, R. Los Alamos National Lab., NM (USA). 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–56: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015273/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Confirmation measurements of special nuclear materials (SNM) are conducted routinely at Los Alamos National Laboratory for inventory support. The main purpose of the measurement is to confirm the stated SNM contents of inventory items and to detect potential diversion or mislabeled materials. The Laboratory implemented the confirmation measurement as part of the inventory verification process in compliance with DOE Order addressing nuclear materials control and accountability. Three measurement techniques/methods were developed for assay of Pu and U bearing items. Acceptance/rejection criteria were established from data collected over several years. This paper describes the measurement techniques, the acceptance/rejection criteria and the resolution practices for items that fail the confirmation measurement tests. Sample data are presented for illustration of each technique. 3 refs., 2 figs., 2 tabs.

40081 (LA-UR–89-2242) **SNM accounting systems: dBase versus C.** Bearse, R.C.; Tisinger, R.M.; Ballmann, J.S. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–53: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015240/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Fuel Manufacturing Facility (FMF) at Argonne National Laboratories-West (ANL-W) in Idaho Falls accomplishes its internal special nuclear material accounting with a PC-based DYnamic Material ACcounting (PC/DYMAC) system developed as a collaboration between FMF and Los Alamos National Laboratory staff members. This system comprises four computers communicating via floppy disks containing transfer information. The accounting software was written in dBase and compiled under Clipper. The decision was made to network the computers and to speed the accounting process. Moreover, it was decided to extend the collaboration to Sandia National Laboratory staff and to incorporate their recently developed CAMUS and WATCH systems to automate data input and to provide a measure of material control. The current version of the code is being translated into the C language. The implications of such a change will be discussed. 9 refs., 3 figs.

40082 (PNL-SA–17174) **Volume calibration techniques for nuclear materials control: A review of ANSI N15.19-1988.** Liebetrau, A.M. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 23p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890736–50: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015835/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Efforts of the INMM Working Group charged with revising the volume calibration standard have culminated in the recent adoption of ANSI N15.19-1988: Volume Calibration Techniques for Nuclear Materials Control. The revised standard represents a significant change over its predecessor in two important areas: data standardization and statistical analysis. The data standardization model is directly applicable to tanks equipped with differential pressure measurement systems for determining liquid height. When measurements differ because of departures from reference temperature, the model specifies procedures for standardizing both calibration data and in-tank liquid height measurements. The model also provides, when necessary, for the standardization of liquid height measurements that vary because of differences in flow resistance in pneumatic lines, differences in the density of air in the vapor head and the reference pressure line, and the density of gas in pneumatic lines. The proposed statistical methods emphasize the use of diagnostic plots and graphical techniques, but also provide a practical method for estimating volume uncertainties when measurement errors are dominated by run-to-run differences. An appendix to the standard contains an extended example that illustrates how the proposed standardization model and statistical methods are used to develop a calibration function. 9 refs., 5 figs.

40083 (SAND–89-1409C) **Addressing the insider threat through the use of a real time personnel and material tracking system.** Trujillo, A.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890889–4: 5. annual symposium on technical displays on physical and electronic security, Philadelphia, PA (USA), 15-17 Aug 1989). Order Number DE89013258/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Past experience in addressing the insider threat has led to the development of general principles for mitigating the insider threat while minimizing adverse impacts on site operations. Among the general principles developed was the requirement for real time tracking of personnel and material. A real time system for personnel and material tracking will aid in mitigating the insider threat by providing critical information regarding the movement and location of personnel and material. In addition, this system can provide an early detection mechanism for potential insider actions. This paper describes the development, operation, and performance of a technology-based system which utilizes radio frequency transmitters to achieve the real time tracking of personnel and material. The major elements of this system are a personnel tracking credential which cannot be removed from an authorized individual without an alarm being sounded, and a material control device which is utilized to control and monitor access to material. These elements form an insider protection system through the use of software which establishes the "rules" under which the system will operate. The performance of this system has been evaluated under both laboratory and operational settings in order to: (1) demonstrate the system's ability to successfully control access to material and areas by personnel, and (2) provide information regarding the status of materials in transit and storage. 3 refs., 1 fig.

0560 Legislation and Regulations

Refer also to citation(s) 39908, 39909, 39926, 39932, 39936, 39939, 39959, 39963, 39964, 39988, 39989, 39994, 39996, 39997, 39998, 40004, 40007, 40017, 40050, 40068, 40074, 40075, 40227

40084 (EPRI-NP–5934, pp. 8.3-8.18) **Mixed waste - the operational impact of regulatory policy.** Silverman, D.J. (Newman & Holtzinger, Washington, DC (USA)). Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, Boulder, CO (USA), 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The purpose of this paper is to discuss the status of the current efforts of the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA) to regulate mixed waste, and in particular, the potential impact of mixed waste regulation on nuclear power plant operations. Although the regulatory scheme is in a state of considerable flux, it is possible to discuss some of the likely impacts on power plant operations and to identify the basic problems associated with mixed waste regulation. The position and recommendations of the industry to date on the issue will also be described.

40085 (INIS-BR–1552) **Nuclear energy and nuclear weapons proliferation.** Agencia de Comunicacao Internacional dos EUA, Rio de Janeiro, RJ (Brazil). [1989]. 23p. (In Portuguese). Order Number DE89633827/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A summary of the report dispatched in the middle of 1978 by the Atlantic Council of United States, organized by North American citizens, is presented. The report considers the relation between the production of nucleoelectric energy and the capacity of proliferation of nuclear weapons. The factors which affect the grade of proliferation risk represented by the use of nuclear energy in the world comparing this risk with the proliferation risks independently of nuclear energy, are examined. (M.C.K.).

40086 (INIS-BR–1553) **Nuclear law and environmental protection.** Vencato, A.C.B. Santa Catarina Univ., Florianopolis (Brazil). Programa de Pos-graduacao em Direito. 1982. 141p. (In Portuguese). Order Number DE89633822/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The imperceptible character of nuclear radiation on the human senses and their harmful effects on living beings and the environment is emphasised. This is based on a review of published works about the concepts of energy and ecology. The potential hazards of a possible nuclear accident and the damage it would cause to a community as well as the problem of radioactive waste disposal are raised. The conclusions and recommendations of the Brazilian Physics Society's Report on Nuclear Pollution are endorsed. The general guidelines of Brazilian Legislation are presented. The legal aspects of nuclear reactor licensing in West Germany, the United Kingdom, France and Brazil are shown from the point of view of the applicable legal system, the licensing bodies, the general frame and scope, public participation, technical safety bodies, as well as the inspection procedures. The concepts of absolute and objective civil responsibility for nuclear damage are reviewed. The judicial principle of equity is considered in view of the exceptional character of the nuclear risk. The main aspects of the international Conventions of Paris, Brussels and Viena on civil ability of nuclear damage are presented. Some philosphical and judicial questions are discussed emphasising the instrumentality of the law control and effective protection. The final suggestion is the exchange of ideas with a view to obtain the maximum safety in the operation of nuclear installations. (author).

40087 The applicability of CERCLA and SARA to releases of radioactive materials. Miller, S.R. (U.S. Dept. of Energy, Washington, DC (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), (1) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), (2) covers the cleanup of releases of radioactive materials from federal and private facilities into the environment. In addition, certain provisions of SARA that do not amend CERCLA also apply to radioactive materials. This dialogue explores the extent to which these laws apply to radioactive materials and the limited exemptions for such materials in these statutes. In addition, the growing overlap between CERCLA and the other federal and state laws that apply to radioactive materials is discussed.

40088 DOE regulation of low-level waste. Chee, T.C. (U.S. Dept. of Energy, Germantown, MD (US)); Hinschberger, S.T.; Logan, J.A. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

Throughout the U.S. Department of Energy (DOE) low-level waste (LLW) management practices are changing. The changes modify practices whereby each DOE site has locally disposed of its LLW (mostly untreated) by shallow land burial using locally-developed waste acceptance criteria. Instead, consistent methods and standards are applied throughout DOE for evaluating and improving LLW management at all DOE sites. Waste generation reduction is emphasized everywhere. Waste treatment is used to a greater extent, to reduce waste volumes and improve waste forms. Improved waste confinement practices are applied where warranted, to stabilize more highly contaminated waste. These and other improvements are being initiated in a program which in preparation is upgrading DOE's overall LLW management plans, regulations and guidance documents.

40089 Regulatory and institutional issues for development of remedial action strategies at ORNL. Kocher, D.C. (Health and Safety Research Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

This paper discusses a number of unresolved regulatory and institutional issues of fundamental importance to the development of strategies for cleanup of sites contaminated by radioactive materials at Oak Ridge National Lab. These issues include (a) the development of criteria for limiting radiation exposures of the public from remedial action sites, (b) the time period to be assumed for active institutional controls over contaminated sites and the location at which such controls are maintained, and (c) the applicability of current standards for radioactivity in drinking water to surface waters and ground waters on the Oak Ridge Reservation. Proposals for resolution of these issues emphasize the need to protect public health, but in a cost-effective manner.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

Refer also to citation(s) 39831, 40029, 40579, 40597, 40834

40090 (IAEA-TECDOC–490, pp. 95-104) **Transport and disposal of cobalt-60 industrial radiation sources.** Kunstadt, P. (Nordion International Inc., Kanata, Ontario (Canada)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8804282–: Task force meeting on public information of food irradiation, Cadarache (France), 18-21 Apr 1988). In *Safety factors influencing the acceptance of food irradiation technology. Report of a task force meeting on public information of food irradiation convened by the International Consultative Group on Food Irradiation and held in Cadarache, France, 18-21 April 1988.* Order Number DE89619871/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This paper will deal with safety aspects of the handling and transportation of Cobalt-60, the most widely used industrial radioisotope. Cobalt-60 is a man-made radioisotope of Cobalt-59, a naturally occurring non-radioactive element, that is made to order for radiation therapy and a wide range of industrial processing applications including sterilization of medical disposables, food irradiation, etc. The shipment of a Cobalt-60 source is the last step in a long and detailed manufacturing and quality control process which includes material specification and preparations, as well as design, manufacture and quality assurance procedures for the encapsulation, reactor targets and shipping containers. The safe transport and disposal of Cobalt-60 industrial radiation sources is essential to the viability of gamma processing technology world-wide. Producers and users of sources are stringently regulated. Transportation packages are tested. Safe disposal options exist and are undergoing continual review. Primary producers such as Nordion International Inc. cooperate fully with regulatory agencies to improve evaluation technology to keep pace with changing requirements. (author). 5 figs.

40091 (INIS-BR–1551) **Aspects of radiation protection to attend the victims of radiological accident with cesium 137 in Goiania.** Hunt, J.G.; Oliveira Filho, D.S. de; Rabello, P.N.P. Instituto Brasileiro do Petroleo, Rio de Janeiro, RJ (Brazil). 1988. 14p. (In Portuguese). (CONF-8806348–: 6. seminar on industrial safety, Curitiba (Brazil), 21-24 Jun 1988). Order Number DE89633080/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The radiological protection measures taken in the general hospital of Goiania (HGG/INAMPS) and in the FEBEM institution, due do the accident involving cesium 137 are described, as well the work of the NUCLEI personnel in the areas of: radiological protection of the medical and auxiliary staff, contamination control of the ward, radiological monitoring of the patients, waste management, personnel and area decontamination and patient transportation. (author).

40092 (INIS-mf–11460, pp. 277-286) **Licensing for industrial gamma and X-ray radiography installation in Peru.** Medina G, E. (Instituto Peruano de Energia Nuclear, Lima (Peru)). Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

According the regulations for ionizing radiation source installations an application to the Peruvian National Authority should be forwarded in order to get the construction on operation license both industrial gamma and X-ray. Radiography is considered as well as personnel aspects. The proceedings are described.

40093 (INIS-mf–11495, pp. 130-132) **On-stream analysis of coal slurries : laboratory research to industrial use.** Watt, J.S. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)); Zastawny, H.W. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

After mining, coal is crushed and then washed in a coal preparation plant to yield a product increased in combustibles and decreased in ash. The fine coal (<0.5 mm) fraction is usually physically beneficiated by froth flotation to yield the low and constant ash product. Flotation circuits are controlled relatively poorly because of the lack of continuous information on solids weight fraction (W) and ash content of coal in the slurry streams about the circuit. Nuclear techniques are widely used for the on-stream analysis of metalliferous mineral slurries, with W being determined by gamma-ray transmission techniques. However, this technique cannot determine W of coal slurries with sufficient accuracy because of the combined

factors of the small density difference between coal and water, and the variable voidage of the slurry. CSIRO has developed and patented a nuclear technique to determine the solids weight fraction, and ash content of coal, in slurries with variable voidage.

40094 (INIS-mf–11495, pp. 227-229) **Localised trace element analysis of water trees in XLPE cable insulation.** Cholewa, M. (Institute of Nuclear Physics, Cracow (Poland)); Hindrichsen, P.F.; Houdayer, A.; Jones, K.W. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

PIXE with a focused proton beam of 30 μm diameter have been used for quantitative trace element analysis of water-trees in XLPE high voltage cable insulation. A major problem in the longevity of underground cables is the premature degradation phenomenon called water treeing. The exact mechanisms of tree initiation and growth are still unclear although many water-trees (especially the so-called bow-tie trees) grow from impurities and voids in the insulation. In agreement with this hypothesis much higher impurity concentrations have been observed in the trees than in the neighbouring insulation. The nature of the impurities vary from tree to tree although sulphur, chlorine and traces of metals always appear to be present. A major problem in the identification of elemental impurities in water-trees is their small size, typically 5 to 200 microns long.

40095 (INIS-mf–11495, pp. 233-236) **Ion beam analysis in mineral exploration and processing.** Sie, S.H. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Ryan, C.G.; Cousens, D.R.; Griffin, W.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Applications of accelerator based analytical methods in the minerals industry are becoming more visible and their impact is beginning to be realised. To date, the most used technique is micro-PIXE with wide ranging applications in both mineral exploration and mineral processing, resolving long standing problems as well as providing novel methodology. Wide acceptance of ion beam analysis by the industry is contingent upon increased reliability, decreasing complexity in use, reduction in cost and more general availability. A number of case histories are presented as illustration.

40096 (INIS-mf–11495, pp. 237-239) **Application of the proton microprobe to diamond exploration and genesis.** Griffin, W.L. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Cousens, D.R.; Ryan, C.G.; Sie, S.H.; Suter, G.; Jaques, L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Proton microprobe analyses of trace elements in indicator minerals from stream sediments may allow identification of multiple source rocks in individual drainages, and discrimination between diamondiferous and barren source rocks. Analyses of mineral inclusions in Argyle diamonds show that the diamonds crystallized over a 400 deg C temperature range, in a rock system undergoing rapid compositional change.

40097 (RNIIRP–88-3) **Application of X-ray fluorescence method to measuring thickness of galvanic coatings and measures of improving sensitivity of such measurings.** Lisin, Yu.D.; Vejts, B.N. Rizhskij Nauchno-Issledovatel'skij Inst., Radioizotopnogo Priborostroeniya, Riga (USSR). 1988. 13p. (In Russian). Order Number DE89633351/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Possibilities of the X-ray fluorescence method in solving type designs for testing thickness of galvanic coatings and its advantages as compared to the β-backscattering method by analyzing random measurement errors, inherent to both methods, are experimentally shown. Using gold coatings on nickel base the efficiency of a method of sensitivity improvement due to application of a selective filter decreasing the measurement errors of the X-ray fluorescence method. 7 refs.; 3 figs.

08 HYDROGEN

0801 Production

Refer also to citation(s) 41335

0802 Storage

40098 (UUIP–1181) **UHV chamber with facilities for accelerator based hydrogen profiling and in-situ sample preparation.** Hjoervarsson, B.; Ryden, J.; Karlsson, E.; Svensson, L.E. Uppsala Univ. (Sweden). Inst. of Physics. Feb 1988. 44p. Order Number DE89902414/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A UHV-system for in situ sample preparation and hydrogen profiling using nuclear resonance reactions e.g. $^{1}H(^{15}N, \alpha\gamma)^{12}C$ has been designed and built. The system includes two evaporation sources, Quartz Crystal Micro balance (QCM) equipment for thickness monitoring, an ion gun for sputtering, a combined pressure cell and vacuum lock for hydration of samples, a mass spectrometer for rest gas analysis, and a RBS detector. Programs for data analysis have been developed. The performance of the system has been checked by preparing and measuring some Mg-Pd samples.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

Refer also to citation(s) 39806, 40117, 40129

40099 (ETDE-mf–9794748) **Investigation of the effects of untreated and of putrefied liquid cattle manure on the nitrogen turnover in Dactylis glomerata L., and on the germination of various plant species.** Merz, H.U. Hohenheim Univ., Stuttgart (Germany, F.R.). Fakultaet 3 - Agrarwissenschaften 1. 27 Jan 1988. 167p. (In German). Order Number DE89794748/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

This study compares the fertilizing effect of untreated liquid cattle manure with that of putrefied liquid cattle manure as it is produced by biogas production. The N-effect on yield and quality of Dactylis glomerata L. was taken as a measurable criterion for the fertilizing effect. The tests were carried out in lysimeters. It proved that the availability of nitrogen depends on the mineralization of the organically bound nitrogen, ie. nitrogen is more easily availabe in putrefied liquid manure. (EF).

40100 (EUR–11195) **Il Prato farm. Demonstration project.** Vincenti, E. Commission of the European Communities, Luxembourg (Luxembourg). 1987. 35p. (In Italian). Available from NTIS (US Sales Only), PC A03/MF A01.

The aim of the project is to integrate, into a farm, a system for the production of alternative energy using almost local resources and to save energy and fertilizers. The IL PRATO farm, near Sassari, has promoted this interesting and complex farm-integrated unit. The production cycle covers various inter-related agricultural sectors, the technical and economic development of which is based mainly on rationalizing the use of energy obtained mostly from the processing of organic waste from poultry breeding (about 100,000 poultry), and to a lesser extent, from the exploitation of wind energy. The farm would thus become completely self-sufficient in energy and would no longer have to rely on expensive fuel and

electricity from conventional sources. The limited size of the farm allows comprehensive testing of the project's efficiency with regard both to intensive farming using organic fertilizers produced on the farm, and to energy-saving. Applicability of the process to this and other sectors: Results since the plant went on stream have shown that the biogas production process in the IL PRATO experiment can be applied to all poultry-farming effluent. It has also been demonstrated that, with very little dilution, anaerobic digestion can be used in any high-efficiency plant for any kind of biomass as long as it contains 8-10% dry matter.

40101 (STUB–22) **Biogas production at low temperatures. Interim report concerning propagation and activity tests of anaerobic psychrophilic bacteria.** Oestergaard, N. Teknologisk Inst., Taastrup (Denmark). Kemiteknik. Jul 1985. 30p. (In Danish). Order Number DE89902322/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Literature concerning biogasproduction at low temperatures was recieved, showing that 1. depending on dry matter content of added substrate psychrophilic or mesophilic bacteria grow up 2. U.A.S.B. filters are able to reduce low concentration waste water at temperatures as low as 10 deg. C. Anaerobic fresh water silt loam from Hakkemosen (bog) in Taastrup, Copenhagen, and siltloam, from Oeresund near Helsingoer was incubated at 18 deg. C in 1 l batch reactors. Small amounts of cellulose, glucose, rumen fluid and degassed separated manure, all sterilized, were added to stimulate bacterial growth. Fresh water silt loam showed gas and methane production. Silt loam from Oeresund was negative. Samples were taken from posotive reactor, and incubated at 18,24 and 35 deg. C using sterile 1:1 rumen fluid:separated swine manure as subsdtrate, added a mineral blend. After 28 days, gasproduction at 18 and 24 deg. C amounted 11 and 53 % of gasproduction at 35 deg. C, giving a V10 (Q10) of 1,62, which indicates presence of psychrophilic menthanogens. (author) 15 refs.

40102 (STUB–24) **Biogas production from materials with a high dry-matter content. Study based on a review of literature.** Oestergaard, N. Teknologisk Inst., Taastrup (Denmark). Kemiteknik. 1985. 33p. (In Danish). Order Number DE89902323/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Biogas production from high dry matter manures was reviewed. Data showed that, acidogenesis was maximal at 55% D.M., and methanogenesis was inhibited at D.M. contents from between 10 and 20%. Spray recirculation using urine or water greatly enhance at biogas production from solid manure. Gas production is linear up to a loading rate of about 10 kg volative solids per m3 and day. Retension times of more than 20 days are required. Data from large scale plants show specific gas production results from 0,267 to 0,4 m3 biogas per kilo D.M. added using batch digesters. Only one large scale continuous reactor was known, and results were not obtainable. (AB) 13 refs.

40103 (STUB–35) **Biogas production following super-thermophilic pre-treatment of biomass.** Oestergaard, N. Teknologisk Inst., Taastrup (Denmark). Kemiteknik. [1988]. 36p. (In Danish). Order Number DE89902321/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Effect of pre-treatment of cow-manure was tested using batch and continuous tests. Using batch tests, pre-treatment was made of 40,55,70,85 and 95 deg. C for up to 24 hours. In all cases, the following gas production was smaller than expected for a 5 week mesophilic digestion period, using a mesophilic culture as inoculation material. Addition of a thermophilic culture before pretreatment enhanced gas production. In all cases the slope of Gvs versus temperature times time (hr) was highest at a pre-treatment temperature of 70 deg. C. Continuous tests were made at a pre-treatment temperature of 70 deg. C, omicron 2,3 and 4 days, and digestion temperatures of 35 deg. C, omicron 5, 7 and 11 days and 52 deg. C, phi 5, 7 and 8 days. Results were compared to mesophilic and thermophilic standard reactors, omicron 15 and 20 days respectively. The results were as follows, calculated as Gvs values: mesophilic standard Gvs varied between 0,095 and 0,245, thermophilic standard Gvs varied between 0,08 and 0,155, pretreatment step Gvs varied between 0,02 and 0,035, separate mesophilic second step Gvs varied between 0,04 and 0,18, separate thermophilic second step Gvs varied between 0,075 and 0,13, coupled pretreatment and mesophilic second step Gvs varied between 0,08 and 0,18, coupled pre-treatment and thermophilic second step Gvs varied between 0,10 and 0,19. The conclusions were: 70 deg. C would be preferable pre-treatment temperature, mesophilic digestion (standard) gave the best gas production as Gvs, 2 step digestion allows much higher loading rates as 1 step digestion, especially compared to one step thermophilic digestion. Following this work 1 common biogas was built with a 55 deg. C pretreatment step, followed by mesophilic digestion second step, and later 2 common plants were rebuilt to use the same technique. (AB).

0902 Alcohol Fuels

Refer also to citation(s) 39806, 40124, 40129

40104 (DOE/ER/13614–3) **The microbiology and physiology of anaerobic fermentations of cellulose: Progress report, November 1988–July 1989.** Peck, H.D. Jr.; Ljungdahl, L.G.; Mortenson, L.E.; Wiegel, J.K.W. Georgia Univ., Athens, GA (USA). 1989. 94p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-86ER13614. Order Number DE89015790/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

In this progress report we describe an integrated study of some individual anaerobic bacteria that are important for the complete conversion of cellulose to methane and CO_2, and of enzymes such as formate dehydrogenase, hydrogenase and CO dehydrogenase which are of special concern to syntropic interactions between the bacteria.

40105 (ORNL/TM–11054, pp. 47-62) **Gaseous products from renewable feedstocks.** Vega, J.L. (Univ. of Arkansas, Fayetteville (USA)); Ackerson, M.D.; Clausen, E.C.; Gaddy, J.L. Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

The purpose of the following is to examine the microbiology and reaction kinetics of producing gaseous products from biomass, with the objective of analyzing reaction rate limitations and improvements. Various bioreactor designs will be examined to determine parameters that minimize reactor volume. Research needs will be assessed in each of these areas.

40106 (ORNL/TM–11054, pp. 63-74) **Liquid products from renewable feedstocks.** Wyman, C.E. (Solar Energy Research Institute, Golden, CO (USA)). Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

In this paper, a brief review will be presented of the potential of biotechnology for production of large volume liquid products such as commodity chemicals and fuels from renewable feedstocks. Emphasis is placed on large volume markets because they could have significant impact on the international competitiveness and security of the US but the research required to mark the technology economically viable is considered too long term to attract the interest of the private sector. Renewable feedstocks are stressed because they provide a domestic, endless supply of raw materials that could be immune to disruption by foreign suppliers and improve international balance of payments. Furthermore, as liquid products derived from these feedstocks are burned, carbon is recycled perpetually between plant matter, liquid products, and carbon dioxide so that carbon dioxide doesn't accumulate in the atmosphere to contribute to the so-called greenhouse effect. Finally, attention is focused on issues in bioprocessing since competitive advantage in areas related to biotechnology may depend as much on advances in bioprocessing as on innovations in genetic engineering. In this regard, it is worth noting that many countries such as Japan have made a major commitment to bioprocessing since they recognize its importance to international competitiveness.

40107 (ORNL/TM–11054, pp. 101-112) **Separations for recovery of biologically produced chemicals.** King, C.J. (Univ. of

California, Berkeley (USA)). Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013795/JAW. Available from NTIS, PC A09/MF A01.

Since biomass is highly oxygenated, chemicals and chemical intermediates made from biomass by fermentation, pyrolysis or other means are also oxygenated. Thus the most readily achievable products are carboxylic acids, alcohols, glycols and related substances. Recovery of these chemicals poses a challenging separation problem, for several reasons: (1) These oxygenated products tend to be highly hydrophilic, have low activity coefficients in aqueous solution, and are therefore difficult to remove from water. (2) The products appear in dilute aqueous solution, posing the problems of recovering from a low-activity medium and handling and processing a large amount of water per unit quantity of product. (3) The solution containing the product is usually complex, containing substantial quantities of similar products and substrates, as well as cellular matter. (4) Except for the simplest carboxylic acids and alcohols, the products are less volatile than water. (5) Residual solvents or other separating agents may have toxic effects upon organisms, if the separation is carried out in the presence of organisms or if the aqueous medium is to be recycled to the reactor. (6) Most organisms of interest are sensitive to elevated temperatures. (7) Fermentations to form carboxylic acids typically perform best at a pH somewhat above the pK_a of the acid, with the result that the product is largely ionized.

40108 Methanol synthesis from hydrogen, carbon monoxide, and carbon dioxide over a $CuO/ZnO/Al_2O_3$ catalyst. 1. Steady-state kinetics experiments. Schack, C.J. (California Univ., Santa Barabara (USA)); McNeil, M.A.; Rinker, R.G. *Applied Catalysis (Netherlands),* 50(3): 247-263 (1 Jun 1989).

The steady-state synthesis of methanol over a commercial low-pressure $CuO/ZnO/Al_2O_3$ catalyst was studied in a fixed-bed, steady-flow reactor with a well mixed fluid phase at pressures of 2.89 MPa and 4.38 MPa, temperatures between 483 K and 513 K, and varying $CO/H_2/CO_2$ compositions. Additional experiments were conducted by replacing carbon monoxide with helium in the feed gas to determine the effect of carbon dioxide on the methanol formation rate. Carbon dioxide was found to contribute significantly to the total production rate of methanol. It was found that the optimum carbon dioxide concentration occurred near 2 mole percent carbon dioxide in the feed. Higher carbon dioxide concentrations resulted in decreasing methanol production rate. In the limited number of experiments in which carbon monoxide was replaced with helium in the synthesis gas, no optimum carbon dioxide concentration, in the range of 2-8 mole percent carbon dioxide in the feed, was found beyond which the methanol production rate decreased. Thus it appears that carbon dioxide inhibits carbon monoxide hydrogenation when above 2 mole percent in the feed but not its own hydrogenation to methanol. Significantly more water was produced during the helium experiments than during those experiments in which carbon monoxide was present in the synthesis gas mixture. Thus, the water-gas shift reaction appeared to proceed in the reverse direction in the helium experiments and in the forward direction when carbon monoxide was present in the feed. 8 figs., 31 refs., 2 apps.

40109 Methanol synthesis from hydrogen, carbon monoxide and carbon dioxide over a $CuO/ZnO/Al_2O_3$ catalyst. 2. Development of a phenomenological rate expression. McNeil, M.A. (California Univ., Santa Barbara (USA)); Schack, C.J.; Rinker, R.G. *Applied Catalysis (Netherlands),* 50(3): 265-285 (1 Jun 1989).

New steady-state kinetics data for the synthesis of methanol from $H_2/CO/CO_2$ over a $CuO/ZnO/Al_2O_3$ catalyst were correlated on the basis of reported catalytic mechanisms to formulate a rate expression for methanol formation. In developing the mechanistic model, it was assumed that hydrogen adsorption occurs on ZnO in contrast to carbon monoxide adsorption on Cu^{1+} and carbon dioxide adsorption on Cu^0. Also, the concentration of sites containing adsorbed hydrogen was assumed constant during reaction. These assumptions led to the formulation of a rate expression containing the sum of contributions from carbon monoxide and carbon dioxide hydrogenation. 6 figs., 49 refs., 3 tabs.

0904 Solid Waste and Wood Fuels

40110 (DOE/CE/40735–1) **Development of a gravel bed combustor for solid fueled gas turbine: Phase 1, Final report, September 1, 1985–January 31, 1989.** Ragland, K.W.; Aerts, D.J. Wisconsin Univ., Madison, WI (USA). Dept. of Mechanical Engineering. May 1989. 81p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-85CE40735. Order Number DE89009029/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A novel pressurized combustor operating on wood chips have been built and tested. Air pressurized to 5 atm and preheated to 230°C flows downward through a bed of wood chips supported by refractory gravel. Over 200 hours of combustor tests were performed in a 23 cm i.d. rig using 1.9 cm yellow poplar wood chips. The following correlation for the burning rate per unit bed cross-sectional area ($kg/hr \cdot m^2$) was obtained as a function of pressure, inlet air temperature, air to fuel ratio and fuel moisture: $G_f = 0.42\ p^{.62}\ T^{1.07}\ (A/F)^{-0.816}\ (100\text{-}M)^{0.60}$. Over 50 hours of combustor tests were run with an Allison model 250 gas turbine attached to the gravel bed combustor. The combustor i.d. needs to be enlarged to more fully load the turbine. A numerical model of the gravel bed combustor was developed which predicts the fuel burning rate and air flow rate for a given set of inlet conditions and excess oxygen in the exhaust. 20 refs., 17 figs., 20 tabs.

40111 (SNV–3521) **Wood or forest fuels. An evaluation focused on soil acidification.** Rosen, K. National Swedish Environmental Protection Board, Solna (Sweden). Oct 1988. 40p. (In Swedish). Order Number DE89902415/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report examines and discusses exploitation of the tree tops, branches, needles and possibly stumps left behind in forests when trees are harvested. The effect of increased biomass removal from forests on plant nutrient and acidification status of forest soils is also discussed. The amount of energy to be produced from forest derived fuels is estimated and this aspect is considered in relation to the burning of coal and oil. (G.B.).

40112 (STEV-FBT–89-23) **Determination of flame-length using light emission measurement techniques.** Rudling, L. Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoping (Sweden). 1988. 28p. (In Swedish). (STUDSVIK-EP–88-39). Order Number DE89902462/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

During combustion of gasifying fuels - e.g. wood - in small boilers with batchwise fuelfeed, it is often very difficult to control the excess of air due to the uneven production of pyrolysis gases. Conventional techniques for regulation of the air excess - e.g. analysis of the oxygen content in the flue gases - are in most cases too expensive in these cases. Instead of determination the air excess by means of flue gas analysis, the air excess can be determined indirectly by measuring the flame-length. The flame-length is inversional proportional to the air excess. In order to measure the flame-length it has been investigated if the emission of light from the flame could be used for that purpose. The investigation has shown, that hydrocarbon flames emit light in the spectral region 450-800 nm which can not only be assigned to the normal black-body radiation from the furnace. The results do also show that the flame-length can be determined by measuring the emission of light, perpendicular to the flame, at different distances from the burner. A photodiode with a maximum sensitivity at 610 nm and a cut off value at >=680 nm was used as photo detector. The experiments also showed that the air excess ratio could be controlled within ± 20% by means of flame-length measurements. (author).

13 HYDRO ENERGY

Refer also to citation(s) 40331

40113 (DOE/ID/12617–T1) **The St. Anthony Falls Independent turbine test facility: Project report No. 288.** Olivier, C.; Voigt, R.L. Jr.; Ramanathan, V.; Gulliver, J.S.; Arndt, R.E.A. Minnesota Univ., Minneapolis, MN (USA). St. Anthony Falls Hydraulic

Lab. Jul 1989. 96p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-86ID12617. Order Number DE89015962/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

In the summer of 1986, the Saint Anthony Falls Hydraulic Laboratory (SAFHL) was selected by the US Department of Energy (DOE) for the development of an independent turbine test facility (ITTF). As a cost sharing project by SAFHL and the DOE, the establishment of an ITTF in the United States provides capabilities needed to the United States hydropower industry. The SAFHL ITTF will aid in the development of improved turbine designs, as well as provide a facility for cavitation, aspiration, and draft tube studies. In addition, the ITTF can provide access to model testing for small manufacturers, as well as being available for comparative model testing. Finally, the ITTF is also a significant instructional tool in training of capable young hydropower engineers. The recent upgrade significantly increases the testing capabilities of SAFHL's ITTF. This report contains the resultant ITTF operating characteristics resulting from this upgrade and previous work. In addition, it briefly describes the physical attributes of the Facility. Also described herein are the data acquisition and analysis systems and the overall accuracy of the Facility, along with a corresponding component-by-component error analysis. 23 refs., 35 figs., 11 tabs.

1306 Environmental Aspects

40114 (CONF-890876–1) **Balancing hydropower development in the Ohio River basin.** Sale, M.J.; Railsback, S.F.; Chang, S.Y.; Coutant, C.C.; Spath, R.E.; Taylor, G.H. Oak Ridge National Lab., TN (USA). 1989. 11p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. From Waterpower '89: international conference on hydropower; Buffalo, NY (USA); 23-25 Aug 1989. Order Number DE89012505/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A large number of retrofit hydroelectric projects have been proposed at existing navigation dams in the Ohio River basin. These proposals involve potentially adverse environmental impacts, including reduced dissolved oxygen concentrations from decreased aeration at dams. The Federal Energy Regulatory Commission completed an environmental impact statement for 24 proposed projects at 19 dams on the Ohio, Monongahela, Allegheny, and Muskingum rivers, evaluating the cumulative impacts of hydropower development on more than 500 miles (800 km) of river. The use of models in this assessment proved extremely valuable for understanding the cumulative impacts of hydropower development on water quality in the basin and for balancing power and environmental quality considerations in the licensing process. 9 refs., 4 figs.

40115 (CRIE–U-87076) **Study on deterioration assessment of existing dam-gate anchorages.** Yamamoto, Koyu; Nakamura, Hideji; Matsuura, Sin'ichi. Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). Technical Lab. No. 2. Aug 1988. 51p. (In Japanese). Order Number DE89772380/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan.

Proper maintenance and operation of hydropower steel structures is an important subject, and an estimation technique is being developed. One of the unsolved important problems is the assessment of dam-gate anchorages, but no assessment technique has been established for the estimation of age deterioration. A study was made on the deterioration assessment of anchorages of the dam crest radial gate, and an assessment procedure is proposed based on the acquired data. To clarify a proper method for the modeling of anchorage, a 1/2 scale model was prepared and subjected to a static load test and structural analysis, offering much information. Concrete items for data acquisition and investigation are shown, and the procedure for structural analysis for age deterioration assessment is introduced. 25 references, 29 figures, 5 tables.

40116 (SV-UB–1987-55) **Study of the long-term resistance of concrete made of slag cement.** Widing, S.; Jansson, S.; Alemo, J. Swedish State Power Board, Vaellingby (Sweden). 17 Dec 1987. 61p. (In Swedish). Order Number DE89902402/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Investigations have been carried out to determine both the magnitude of the leakage and the chemical composition of the river and leaking water. Furthermore, thin grinded samples have been taken from cores of the concrete. No significant changes were observed in the structure of the concrete or the chemical composition of the leaking water. It should be mentioned, however, that this particular concrete has a lower capacity for autogenous healing than concrete made of Portland cement as the slag cement has a very low lime content. (The lime will normally be leached in the leaking water from the concrete and then precipitated in the cracks and on the surface of the concrete in contact with air, thus healing fine cracks.) The slag binds the free calcium hydroxide which will give a better resistance against leaching. The somewhat lower tension strength during cooling together with a normal deformation at the end of the hardening process has created a high number of microcracks with leaking water. This fact combined with the very low capacity for autogenous healing of cracks with no lime precipitation seems to be the main reason for the problems that have arisen in using this particular type of slag cement in heavy concrete structures exposed to high water pressures.

14 SOLAR ENERGY

Refer also to citation(s) 40376

1405 Solar Energy Conversion

Refer also to citation(s) 40099, 40100, 40101, 40102, 40103, 40104, 40105, 40106, 40107, 40412, 40484, 40503, 40558, 40559, 40560, 40569, 40932

40117 (CFS/NF–8710, pp. 63-78) **Innovations for hardwood utilization. Catalysed organosolv pulp and saccharification.** Paszner, L (Univ. of British Columbia, Vancouver, BC, Canada); Cho, P.H.J. Canadian Forestry Service, Edmonton, AB (Canada). Northern Forest Research Centre. 1987. (CONF-8710145–: Biochemical conversion program annual review meeting, Golden, CO (USA), 13-15 Oct 1987; MICROLOG–89-01396). In *Proceedings of the workshop on aspen pulp, paper and chemicals*. Available from Northern Forestry Centre, 5320 - 122 Street, Edmonton, AB, Canada T6H 3S5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Organosolv processing of wood to pulp and dissolved wood chemicals uses a water-miscible organic solvent, such as an alcohol or ketone, and a suitable catalyst. By slight modifications to the organosolv chemistry, the process is converted into a highly efficient wood hydrolysis process which quantitatively decomposes wood into sugars and lignins. These can serve as basic feedstocks for production of alcohols and other liquid fuels or chemicals. The process can produce bleachable grade pulps at a wide range of yields, does not require expensive technology with consequent high capital costs, has minimal water supply criteria and effluent disposal problems, and is adaptable to various tree species. Advantages are outlined for use of the process in Alberta, where underutilized aspen resources and wood wastes are suggested as a source for the raw material for the process. Integrated production of pulp and paper along with fuel ethanol and lignin byproducts is considered to be a highly attractive means to maximize the value of the province's unused wood resource. Economic calculations, presented for wood-waste processing plants that use an organosolv process modified for maximum hydrolysis, indicate that at current prices, plants as small as 110 tons per day of feedstock consumption seem to be economically viable. 9 refs., 4 tabs.

40118 (CONF-8905146–2) **A structural basis for electron transfer in bacterial photosynthesis.** Norris, J.R.; DiMagno, T.J.; Angerhofer, A.; Chang, C.H.; El-Kabbani, O.; Schiffer, M. Argonne National Lab., IL (USA). 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 22. Jerusalem symposium on quantum chemistry; Jerusalem (Israel); 15-18 May 1989. Order Number DE89015702/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Triplet data for the primary donor in single crystals of bacterial reaction centers of Rhodobacter sphaeroides and Rhodopseudomonas viridis are interpreted in terms of the corresponding x-ray structures. The analysis of electron paramagnetic resonance data from single crystals (triplet zero field splitting and cation and triplet linewidth of the primary special pair donor of bacterial reaction centers) is extended to systems of a non-crystalline nature. A unified interpretation based on frontier molecular orbitals concludes that the special pair behaves like a supermolecule in all wild-type bacteria investigated here. However, in heterodimers of Rb. capsulatus (His^{M200} changed to Leu or Phe with the result that the M-half of the special pair is converted to bacteriopheophytin) the special pair possesses the EPR properties more appropriately described in terms of a monomer. In all cases the triplet state and cation EPR properties appear to be dominated by the highest occupied molecular orbitals. These conclusions derived from EPR experiments are supplemented by data from Stark spectroscopy of reaction centers from Rb. capsulatus. 41 refs., 3 tabs.

40119 (CONF-8906129–1) **Controlling photoinduced electron transfer rates in donor-spacer-acceptor molecules by changing the electronic properties of the spacer.** Wasielewski, M.R.; Niemczyk, M.P.; Johnson, D.G. Argonne National Lab., IL (USA). 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 13. DOE solar photochemistry conference; Silvercreek, CO (USA); 11-15 Jun 1989. Order Number DE89015128/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This research addressed electron transfer in photosynthetic reaction centers. Specifically, the nature of the medium that lies between the electron donors and acceptors in the reaction centers has been studied. The approach was to synthesize four fixed-distance porphyrin-quinone molecules in order to study the effects of changing the orbital energies of the donor, acceptor, and intervening spacer molecules. (CBS)

40120 (DOE/ER/13621–3) **Transcriptional analysis of the R locus: Progress report, October 1988–June 1989.** Wessler, S.R. Georgia Univ., Athens, GA (USA). Dept. of Botany. Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-86ER13621. Order Number DE89015796/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The cloning and preliminary characterization of the R-nj allele is described elsewhere. Most of this progress report represents a summary of two additional manuscripts describing our characterization of the Lc gene and describing a transient assay for R function using the particle gun.

40121 (DOE/ER/13739–2) **[Molecular studies of functional aspects of plant mitochondrial proteins]: [Annual performance report for 1988–1989].** Siedow, J.N. Duke Univ., Durham, NC (USA). [1989]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER13739. Order Number DE89015815/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The work relating to cytoplasmic male sterility (cms) in the original DOE proposal outlined a wide ranging series of studies looking at several features of plant mitochondrial structure/function that related to cms. One particular line of interest was the relationship between the appearance of both cms and sensitivity to certain pathotoxins (produced by the fungi Bipolaris maydis and Phyllosticta maydis and collectively referred to as T-toxins) in cms-T maize (2). Results over the past ten years from numerous laboratories have established that T-toxin specifically affects mitochondria isolated from cms-T maize (2). Further, the effects of T-toxin on cms-T mitochondria (inhibition of malate oxidation, uncoupling and leakage so small molecules such as Ca^{++} or NAD^{+}) have led to the view that the interaction of T-toxin with cms-T mitochondria leads to a permeabilization (i.e., channel formation) of the inner membrane (7). The research carried out in connection with this grant over the past two years has gradually focused on studies of a 13 kDa protein (URF13), coded for by a mitochondrial gene (T-urf13) (12), that is correlated with both male sterility and T-toxin sensitivity in cms-T maize (Fig. 1: NOTE – all figure citations refer to figures appearing in Appendix B). More specifically, the research has addressed features of URF13 structure that contribute to membrane channel formation and its interaction with T-toxin. 4 refs.

40122 (ETDE-mf–9795107) **Silicon ribbon by rapid solidification.** Beichler, J.; Grimm, W.; Tenbrink, J. Vacuumschmelze G.m.b.H., Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1987. 67p. (In German). Contract BMFT 03E-8332-A. Order Number DE89795107/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

Polycrystalline silicon ribbons were prepared under vacuum by SRCT (Single Roll Casting Technique). The ribbon thickness was in the range of 50 ... 200 μm. The processing parameters were tackled out experimentally as well as theoretically. For the design of the nozzle different shapes and materials were tested. The crucible was made of high purity graphite. For the wheel copper was used. First attempts were undertaken to produce ribbon pieces with constant length. Grain sizes up to 200 μm could be obtained by this method. First photoelectric results of test cells showed open circuits voltages up to 413 mV and short circuits currents up to 10.5 mA/cm^2 (without antireflection coating). From surface photo voltage measurements (SPV) the diffusion length of the minority carriers was detected to be 10 to 20 μm, sometimes values up to 30 μm could be obtained. (orig.) With 40 refs., 25 figs., 7 tabs.

40123 (EUR–10386) **Experimental analysis of a biomass pyrolysis plant and characterization of the conversion products (the pyrolysis plant belonging to Italenergie, Sulmona in the Abruzzo region of Italy).** Leonardini, L. Commission of the European Communities, Luxembourg (Luxembourg). 1986. 18p. (In Italian). Available from NTIS (US Sales Only), PC A03/MF A01.

The aim of the research was to evaluate the efficiency of a biomass pyrolysis plant in collaboration with Italenergie (Sulmona). The products combustion specifications were characterized. The pyrolysis plant has been designed for a capacity of 1 ton/h dry biomass. The different parts of the installation are: the unity of biomass preparation (grinding, drying) the pyrolysis unit (fluidized bed reactor) the product separation unit (cyclon for carbon-gas separation, washing tower and filters for the condensible fraction recuperation). Non-condensable gases are used for biomass drying. Results: The principal parameters of the flow sheet were measured on the experimental plant. This includes the analysis of chemical biomass composition and bio-oil composition, material flow, gas flow, energy flow. Owing to the characteristics of the biomass, the global thermal efficiency of the plant is about 54-60%.

40124 (NEDOJ–8811) **FY 1987 NEDO annual report (Part 2).** Matsuoka, Minoru. New Energy and Industrial Technology Development Organization, Tokyo (Japan). Sep 1988. 527p. (In Japanese). Order Number DE89760509/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - Available from New Energy and Industrial Technology Development Organization, Tokyo, (Japan).

This is Part II of FY 1987 NEDO (New Energy Development Organization) Annual Report which describes the following items. I. Solar energy technology development: Commercialization of photovoltaic power generation. Low cost silicon experimental purification demonstration. Solar cell panel experimental fabrication demonstration. Commercialization study of highly efficient crystalline solar cell. Commercialization study of amorphous solar cell. Development of solar cell evaluation system. Study on the peripheral technologies. Centralized photovoltaic generation system. Solar-thermal hybrid system. Giant wind power generation system. Medium scale rural photovoltaic generation system. II. Development of fuel and storage technology: Fuel cell generation technology (Phosphate type, molten carbonate type, etc). New type cell power storage system. General use stirling engine. III. Development of alcohol-biomass technology. Total 527 pages. 248 figures, 78 tables.

40125 (ORNL/FTR–3311) **[CO_2 chemistry and biochemistry, Ginosa Marina, Italy, June 17-28, 1989]: Foreign trip report.** Hartman, F.C. Oak Ridge National Lab., TN (USA). 11 Jul 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015733/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended a conference organized by the NATO Advanced Study Institute on plant molecular biology and presented two invited addresses entitled "Rubisco: Active-site characterization and mechanistic implications." Presentations concerning biological

CO_2 fixation, chemical modifications of proteins, site-directed mutagenesis, CO_2 chemistry, carbonic anhydrase, biotin-requiring enzymes, and the greenhouse effect were relevant to ongoing investigations of the Protein Chemistry Group and the Protein Engineering Program at ORNL's Biology Division.

40126 (ORNL/TM–11054, pp. 37-46) **Bioprocessing applications for fossil energy.** Scott, C.D. Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

With the advent of modern bioprocessing techniques, an increasing number of concepts that are available for consideration in the processing of fossil fuels. The bioprocessing systems that have been proposed or can be envisioned for the future involve almost all aspects of coal utilization as well as several areas in oil and gas extraction and processing. The advantages of highly specific biocatalytic action, mild operating conditions, and the potential for efficient bioreactor systems make these new processing concepts quite attractive. Unfortunately, very few have been developed to the extent that a firm economic process analysis can be made. Additional research and development will be required in order to bring such innovative concepts to the industrial sector. This will require generic bioengineering research on advanced bioreactor systems, innovative separation concepts, and bioprocess control and integration as well as bioprocess development for specific processing systems. The primary bioprocessing concepts for application to fossil energy include enhancing the extraction and recovery of petroleum and other carbonaceous materials; beneficiating coal by removal of sulfur and other components; converting coal to useful liquid or gaseous products; upgrading product quality with removal of detrimental and hazardous components; and utilizing environmental control technology for gaseous and liquid effluents and solid residues. Several of these potential bioprocessing systems will be described in more detail.

40127 (ORNL/TM–11054, pp. 87-95) **Bioreactor fundamentals.** Blanch, H.W. (Univ. of California, Berkeley (USA)). Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

Over the last ten years a number of both novel bioreactors and biologically-catalyzed reactions have appeared, some of which have the potential to open new avenues in the use of enzyme and microbial processing for energy and chemicals production. Thus the author shall consider the bioreactor to encompass both the reactor itself and the enzymatic or cellular process occurring in it. Bioreactor fundamentals can be examined from the perspective of the types of products formed or reactions catalyzed, noting that in the case of environmental control, the reaction considered may be adsorption. This product focus is important, as the economic and technical feasibility of many processes depends on a variety of factors, only one of which is the suitability of a particular bioreactor. Prior to the advent of genetic engineering, novel bioreactors were often developed to overcome limitations imposed by the organism (eg. extractive fermentation to reduce product inhibition), whereas today biological approaches may be available. Appropriate alteration of the microorganism or enzyme may result in conventional bioreactors being entirely suitable for the product under consideration. There is a considerable body of literature concerning conventional bioreactors, including stirred tank and pneumatically agitated reactors. The author focuses attention on novel bioreactors. There continue to be a number of fundamental problems that need to be addressed in the area of multiphase bioreactors and these will be examined in terms of the application of conventional bioreactors for some of the products of interest.

40128 (ORNL/TM–11054, pp. 97-99) **Bioreactor fundamentals.** Venkatatasubramanian, K. Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

The industrial application of bioreactor systems is slowly evolving from the classical batch stirred tanks to continuous operation utilizing several different approaches. Many of these advanced concepts are just beginning to be introduced. For example, they are now seeing improved aeration and agitation techniques and process monitoring and control systems are becoming meaningful. New and improved bioreactor configurations are also being considered. These include continuous columnar systems such as airlift and tower bioreactors as well as membrane systems. It has been demonstrated that for some of these new concepts, the use of immobilized biocatalysts allow high productivities, at high flowrates without catalyst washout. Some bioreactor concepts must accommodate much different biocatalysts than the microorganisms or enzymes that have been usually considered. For example, mammalian and hybridoma cells are now extensively sued and plant cells and even insect cells are being investigated. These different types of cells are, in general, more fragile and require a reactor design that has reduced shear force while maintaining good process control and mass transport. Research needs in this area certainly include advanced bioreactor designs that operate on a continuous basis with improved process control. The latter will require stable and sensitize on-line monitoring of various process parameters with advanced computer interfacing. Scale-up criteria must be predictable and the system should be amenable to aseptic operation with good operational characteristics such as low pressure drop and improved CO_2 removal.

40129 (ORNL/TM–11054, pp. 113-125) **Bioseparations: some research directions.** Hatton, T.A. (Massachusetts Institute of Technology, Cambridge (USA)). Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

The goal of this paper is to outline areas that appear fruitful for future research into bioseparations, with an emphasis on generic processes that can have an impact on energy-related applications. These applications include the production of oxychemicals for fuels and feedstocks, and polymers such as xanthan gum for use in tertiary oil recovery operations. In many cases, as in the bioconversion of starch to ethanol, crude preparations of enzymes are required, and efficient methods are needed for their isolation and purification from fermentation media.

40130 (ORNL/TM–11054, pp. 127-138) **Bioprocess integration and control fundamentals.** Wang, D.I.C. (Massachusetts Institute of Technology, Cambridge (USA)). Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

The control of bioprocesses is important to ensure achieving the necessary product concentration, productivity and conversion efficiency. However, one of the major problems facing bioprocess control is the lack of sensors to monitor the pertinent variables. This critical need has been addressed throughout the years but unfortunately advances have been rather minimal. In view of the importance of biosensors and monitoring techniques, this topic will again be repeated. Biosensors and monitoring in energy related research are quite generic since fundamental discoveries and applications are translatable to other biotechnology systems. Therefore, advancements can be considered to be useful to all sectors of the bioprocess industry. It is the intent of this paper to address some of the present and future needs in bioprocess sensor and monitoring which will ultimately lead to optimal process control. The second area to be addressed deals with the integration of bioprocesses. In recent years, reasonable efforts have been made by the Biochemical Engineering community to examine this concept. The concept to integrate bioprocesses is quite natural since solutions could alleviate some of the bottlenecks in the use of biological systems for the production of fuels and chemicals.

40131 (ORNL/TM–11054, pp. 139-154) **Issues on bioprocess integration, modeling, and control.** Shuler, M.L. (Cornell Univ., Ithaca, NY (USA)). Oak Ridge National Lab., TN (USA). Apr 1989. (CONF-8811104–Summs.: Meeting on bioprocessing research for

energy applications, Alexandria, VA (USA), 2-4 Nov 1988). In *Bioprocessing research for energy applications.* Order Number DE89013735/JAW. Available from NTIS, PC A09/MF A01.

The purpose of this paper is to discuss how bioprocess integration of recovery and fermentation can lead to novel reactor configurations with potentially enhanced productivity and how computer-based models of cellular systems may lead to improvements in bioreactor operating and control strategies. Further models may aid the process integration task by providing a complete overview of a process and integration of components.

40132 (SAND–89-1543) **1989 DOE/Sandia crystalline photovoltaic technology project review meeting.** Basore, P.A. (ed.). Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 211p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890795–: DOE/Sandia crystalline photovoltaic technology project review meeting, Albuquerque, NM (USA), 11-13 Jul 1989). Order Number DE89013881/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This document serves as the proceedings for the annual project review meeting held by Sandia's Photovoltaic Cell Research Division and Photovoltaic Technology Division. It contains information supplied by each organization making a presentation at the meeting, which was held 11-13 July 1989 at the Marriott Hotel in Albuquerque, NM. Information supplied by other Sandia contractor and single-page data sheets generated by the cognizant Sandia Technical Liasion for each contract are also included. Sessions were held to discuss national and international photovoltaic programs, one-sun crystalline silicon cell research, concentrator silicon cell research, concentrator III-V cell research, and concentrating collector development.

40133 (SERI/STR–211-3530) **Structure of amorphous silicon alloy films: Annual subcontract report, January 15, 1988–January 14, 1989.** Norberg, R.E.; Fedders, P.A. Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 31p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009441/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The principal objective of this research program has been to improve the understanding at the microscopic level of amorphous silicon-germanium-alloy films deposited under various conditions to assist researchers to produce higher quality films. The method has been a joint theoretical and experimental approach to the correlation of NMR, ESR, and other characterizations, especially relating to rearrangements of hydrogen. Deuteron magnetic resonance reveals the presence of (and changes in) tightly bonded hydrogen (deuterium), weakly bonded hydrogen, molecular hydrogen, and rotating silyl groups. Microvoids are investigated via observation of para D_2 for which ΔM_J transitions are frozen out. Solid echoes reveal HD and ortho D_2 trapped as singles in the semiconductor matrix. Theoretical calculations show dangling bonds to be more likely than floating bonds. 23 refs., 11 figs.

40134 (STEV-EO–89-9) **Optimization of biomass production at Salix cultivation.** Christersson, L.; Ericsson, T. Statens Energiverk, Stockholm (Sweden). 1989. 51p. (In Swedish, English). Order Number DE89902416/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The third optimization experiment on sandy soil at Halland has been planned and prepared during the year 1987. This is the first year of a three years' project concerning clones of young stages of willow and poplar. The contamination of ground water has been investigated and the conditions of cultivation have been controlled, particularly the development of the irrigation-fertilization system. The aim of the project is to decide the optimum productivity under various climatic and soil conditions in south and middle Sweden. (G.B.).

40135 (STEV-EO–89-10) **Plant cultivation - annual report 1988.** Eriksson, G. Statens Energiverk, Stockholm (Sweden). 1989. 10p. (In Swedish). Order Number DE89902417/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

During 1987/88 new plantation areas have been prepared and put into use. The locals for field projects have been made ready after careful control of local climate and soil conditions. The erection of a greenhouse has been delayed. A review concerning the state of the art of Salix genetics is under preparation. (G.B.).

40136 (STEV-EO–89-11) **Energy forest cultivation in the province of Kronoberg. Full-scale test South, final report 1989.** Westerberg, I. Statens Energiverk, Stockholm (Sweden). Feb 1989. 31p. (In Swedish). Order Number DE89902460/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The aim of the project was to investigate the possibilities of cultivating energy forest on abandoned farming ground. The resulting fuel costs should then reach a break-even point. Approximately 65 ha ground was cultivated, mainly by manual work. Planting was made in spring. Frost injuries were severe in the autumn of 1981. Additional damage was caused by the dry summer of 1983 so that only 30 ha of the plantation were available for harvesting. When 4 ha were harvested in 1986 the result was 7-12 ton dry matter per ha, as fuel chips, 155 kg dry substance per m^3 with 26% water content. It is concluded that this type of energy forestry does not pay its way. (G.B.).

40137 (STEV-FGT–89-2) **Progress report - gasification diesel generator S.** Waldheim, L. Statens Energiverk, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Feb 1989. 15p. (In Swedish). (STUDSVIK-EP–89-2). Order Number DE89902418/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The gasification technique of Studsvik eliminates the operaticnal and environmental problems caused by tar. The pilot gasifier of 2 MW has been refitted with a gas purification stage and a diesel engine with an effect of 500 kW. Seven tests of one week each have been performed. A series of experiments with a duration of 1000 hrs at a cost of MSEK 10 is being planned. (G.B.).

40138 (STEV-FGT–89-3) **Gasification of peat and biomass II KTH. Final report of stage 9, 1987 July - 1988 June.** Sjoestroem, K. Statens Energiverk, Stockholm (Sweden); Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology. Mar 1989. 266p. (In Swedish, English). (KTH-KTR–89-12). Order Number DE89902419/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

Work during the stage has mainly been aimed at improving equipment and methods of surveillance and analysis. This is part of our changed aim from process studies to basic research on gasification. A new gas chromatograph has been installed, which now makes it possible for us to analyze both permanent gases and hydrocarbons up to C_7 at intervals of 7 to 8 minutes. This chromatograph is used with the pressurized gasifier and the pressurized pyrolysis equipment as well as with the tar cracking equipment. The pressurized pyrolysis equipment still shows some problems in experiments with biomass at pressures higher than 0.5 MPa. Theoretical calculations on the flow profile in the free-fall tube have shown that there is free convection in the tube. This causes a stream of gas to go upward along the wall and a cold stream to go downward in the center of the tube. This phenomenon is enhanced by increasing pressure. A series of experiments have been made where the pressure and the flow of carrier gas were varied. Analytical work is aimed at characterization of key components in the condensed tar. A smaller series of experiments has been made using dolomite from Glanshammar as catalyst for tar break-down. Scattering of results impede determination of whether there is any difference relative to the experiments using dolomite from Sala. The equipment has been rebuilt to lessen the scattering in experimental results. The pyrolysis oven has been equipped with three separate heaters with individual controls. The cata- lytic oven has been rebuilt in the same way. A library of references with at present around 1500 titels has been established.

40139 (STEV-FGT–89-4) **Bio-gasification LTH. Progress report stage 7.** Andersson, L.; Bjerle, I.; Forkman, M.; Hallgren, A.; Holst, L. Statens Energiverk, Stockholm (Sweden). Apr 1989. 71p. (In Swedish). Order Number DE89902461/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This report deals with three different research areas, namely * gasification of biomass in a drop-tube reactor, * investigation of char reactivity by a thermobalance, * separation of H_2O at high temperature by means of calcium adsorbents. The work with a model for temperature profile and residence time in the drop-tube furnace has

been continued. The theoretical relationships have been transferred to computer codes.

40140 Research progress in the DOE/SERI Amorphous Silicon Research Project. Sabisky, E. (Solar Energy Research Institute, Golden, CO (US)); Wallace, W.; Stafford, B.; Sadlon, K.; Luft, W. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

The Amorphous Silicon Research Project (ASRP), established at the Solar Energy Research Institute (SERI) in 1983, is responsible for all U.S. DOE government supported research activities in the field of amorphous silicon photovoltaic. The objectives and research directions of the project have been established by a Five Year Research Plan developed at SERI in cooperation with the Department of Energy in 1984. In order to accomplish project goals, research is performed by a combination of i) multi-year programs consisting of multi-disciplinary research teams based on strong government/industry partnerships and ii) basic research performed in university, government and industrial laboratories. A summary of recent research progress in the ASRP program is presented.

40141 Tunneling contributions to nip and pin hydrogenated amorphous silicon devices. McMahon, T.J. (Solar Energy Research Institute, Golden, CO (US)); Madan, A. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

It is well known that the performance of hydrogenated amorphous silicon (a-Si) p-i-n type devices is determined by the sequence of deposition. For instance, the stainless steel/p-i-n configuration generally shows a larger value of the open circuit voltage (up to 200mV) compared to the n-i-p sequence of deposition. Explanations of this phenomena such as the Dember potential, self field effect, residual doping, hydrogen effusion effects associated with the p^+ layer deposition process are unable to satisfactorily explain the difference in performance. The authors have performed a systematic study to examine the difference between the two configurations and used dark and light current-voltage characteristics, SIMS, junction recovery and device modelling. After pointing out flaws in previous studies, they present a plausible alternative explanation which relies on tunneling at the p^+-i interface to explain some of the observed differences in the performance of these devices.

1406 Photovoltaic Power Systems

Refer also to citation(s) 40124, 40324

40142 (ECN–89-073) **Electric conversion systems for photovoltaic applications.** Coppelmans, C.M.M.; Op 't Hoog, A.J.C. Netherlands Energy Research Foundation, Petten (Netherlands). May 1989. 180p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The purpose of this study is to develop and optimize an energy conversion system for a power grid connected photovoltaic system with a corresponding control system. Three systems are distinguished: independent power operation with batteries as a buffer; power grid connected operation with batteries as a buffer; and, power grid connected operation without batteries. The next elements are part of these photovoltaic systems: photovoltaic array, regulator or control, buffer and inverter. In particular the technical aspects of the last two systems are discussed. First the principles of photovoltaic cells are explained. Then the possible realizations of a regulator, capable to generate the maximal power from the photovoltaic cells, are dealt with. Subsequently some inverters are discussed as well as requirements for the application of inverters in photovoltaic systems. Finally some recommendations and conclusions are given. 51 figs., 19 refs., 2 tabs., 36 apps.

40143 (ECN–89-102) **Measurements on the emergency power system for a solar house in Castricum, Netherlands.** De Bonte, J.A.N.; Kraaijvanger, A.W.; Warmenhoven, A. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1989. 31p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Within the framework of the Netherlands Energy Research Foundation (ECN) Project Electric Conversion Systems, measurements have been carried out as stated in the title. The electric energy supply of the house consists of a photovoltaic system in combination with a 24 V storage battery. A small gas unit is attached to the system to charge the batteries in case of emergency. To control a correct operation and dimensioning of this emergency power supply measurements were carried out in the ECN Laboratory for Electric Conversion Systems (LECS) on the gas unit in combination with a controlled battery charger and a 24 V battery. A short description of the measuring equipment and the measurements is given. The measurement results are presented and discussed with regard to the starting points to which the system has to meet. 10 figs., 8 tabs., 3 apps.

1407 Solar Thermal Power Systems

40144 (DOE/NASA/33408–3) **Comparison of conceptual designs for 25 kWe Advanced Stirling Conversion Systems for dish electric applications.** Shaltens, R.K.; Schreiber, J.G. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AT04-85AL33408. (NASA-TM–102085;CONF-890815–17: 24. intersociety energy conversion engineering conference, Washington, DC (USA), 7-12 Aug 1989). Order Number DE89013337/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Advanced Stirling Conversion System (ASCS) Project is managed by NASA Lewis Research Center through a cooperative Interagency Agreement with DOE. Conceptual designs for the ASCS's were completed under parallel contracts in 1987 by Mechanical Technology Inc. (MTI) of Latham, NY, and Stirling Technology Company (STC) of Richland, WA. Each design features a free-piston Stirling engine, a liquid metal heat pipe receiver, and a means to provide about 25 kW of electric power to a utility grid while meeting DOE's long term performance and cost goals. An independent assessment showed that both designs are manufacturable and have the potential to easily meet DOE's long term cost goals. 9 refs., 12 figs., 4 tabs.

40145 (SAND–89-0899) **Test results from bench-scale sodium-pool-boiler solar receiver.** Moreno, J.B.; Andraka, C.E. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 148p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE89013971/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

A liquid-metal pool-boiler solar receiver has been proposed to link a paraboloidal-dish concentrator to a Stirling heat engine operating in the temperature range 700–800°C. Preliminary to the construction of a full-scale receiver of this type, a bench-scale version using liquid sodium was designed, built and tested. Conclusions drawn from the test included: (1) boiling instability will occur in the full-scale receiver unless special measures are taken, (2) boiling was stabilized in the bench-scale receiver after the addition of "artificial cavities", but other stabilizing influences may also have been present, (3) "hot restarts" can under some circumstances lead to unacceptably-high incipient-boiling superheats, (4) no thermal-fatigue damage was evident after 100 hours of boiling interspersed with 24 cooldown periods, (5) 0.01-inch-diameter sheathed thermocouples used to provide an estimate of heated-wall temperature survived over 100 hours at 830°C, and (6) other instrumentation and control techniques that were tested were shown to be appropriate for future full-scale receiver tests. 27 refs., 24 figs., 4 tabs.

1408 Ocean Energy Systems

40146 (SERI/STR–253-3485) **Technology Development Plan: Geotechnical survey systems for OTEC [Ocean Thermal Energy Conversion] cold water pipes: Final subcontract report.** Valent, P.J.; Riggins, M. Solar Energy Research Inst., Golden, CO (USA). Apr 1989. 79p. Sponsored by U.S. DOE Conservation & Renewable

Energy. DOE Contract AC02-83CH10093. Order Number DE89000899/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report provides an overview of current and developing technologies and techniques for performing geotechnical investigations for siting and designing Cold Water Pipes (CWP) for shelf-resting Ocean Thermal Energy Conversion (OTEC) power plants. The geotechnical in situ tools used to measure the required parameters and the equipment/systems used to deploy these tools are identified. The capabilities of these geotechnical tools and deployment systems are compared to the data requirements for the CWP foundation/anchor design, and shortfalls are identified. For the last phase of geotechnical data gathering for design, a drillship will be required to perform soil boring work, to obtain required high-quality sediment samples for laboratory dynamic testing, and to perform deep-penetration in situ tests. To remedy shortfalls and to reduce the future OTEC CWP geotechnical survey costs, it is recommended that a seafloor-resting machine be developed to advance the friction cone penetrometer, and also probably a pressuremeter, to provide geotechnical parameters to shallow subseafloor penetrations on slopes of 35° and in water depths to 1300 m. 74 refs., 19 figs., 6 tabs.

1409 Solar Thermal Utilization

Refer also to citation(s) 40320

40147 (BFR-R-24-1989) **Application of passive solar heating. Resource economical housing estate at Karlstad.** Blomsterberg, Aa.; Eek, H. Swedish Council for Building Research, Stockholm (Sweden). 1989. 140p. (In Swedish). Order Number DE89902471/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The report presents planning, projecting and realization of an housing estate comprising 16 terraced house flats and a non-residential building for various activities of the community. The district was built in 1984 to provide i.a. energy economical living and utilization of passive solar heating. Measurements during two years point out the possibility of attaining a low energy consumption and a good indoor climate in a terraced house with a simplified heating system and a glazed room.

40148 (BFR-R-26-1989) **Solar heating in a district heating system for Nykvarn.** Hansson, G.; Isakson, P. Swedish Council for Building Research, Stockholm (Sweden). 1989. 106p. (In Swedish). Order Number DE89902472/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The installation comprises 4000 m^2 flat plate collectors located on a field. The heat is short-time storaged in an accumulator and is supplied to the Nykvarn district heating system. A little less than 700 substations are connected, and the maximal output requirement is c. 8 MW. The remaining heat is produced by oil and electricity. The solar installation works well, and the maintenance is moderate. The solar collector heat production amounted to 0.34 MWh/m^2 from July 1987 to June 1988. 0.29 MWh was used in the district heating system. The efficiency of the solar heating installation to the system was 29%, which made up 6.5% of the Nykvarn yearly demand. (With 32 diagrams).

40149 (ETDE-mf-9794850) **A solar system for service water-heating in the children's Hospital in Esslingen.** Lippe, W. Stadt Esslingen (Germany, F.R.). Bauverwaltungsamt; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1987. 63p. (In German). Order Number DE89794850/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

The solar system (collector surface = 341,8 m^2) serves for pre-heating water in the Municipal Children's Hospital (169 beds) and the main building (508 beds) of the Municipal General Hospital in Esslingen on Neckar. The solar pre-heating system is hydraulically connected to the conventional water heating system and designed in such a way that in the case of a solar energy surplus it can compensate the circulation losses of the water heating system over a limited period of time. As the hot water demand of the Children's Hospital was lower than assumed it was possible to connect the main building to the system as well. Daily water consumption has since then been around 14,8 m^3 with peak demand in the morning hours. Due to gravity circulation the heat transmitter of the collector circuit became so cold that the service water froze which caused frost damage. (orig.).

40150 (EUR-10313) **Analysis of the sensitivity and pertinence of network data. Collections in the Paris region.** Adnot, J.; Bourges, B.; Watremez, G. Commission of the European Communities, Luxembourg (Luxembourg). 1985. 54p. (In French). Available from NTIS (US Sales Only), PC A04/MF A01.

The Sensitivity of the results of Performance Computations for Solar Equipments to the quality of Meteorological Data gives information: about the systems and the best way for modelling them, about the pertinence of Available Network Data. The present Analysis of the Sensitivity and Pertinence of Network Data is limited to flat-plate collectors: Non Selective between 10 and 50°C Selective between 10 and 50°C High Performance between 50 and 100°C. It allowed for the comparison of three models (Reference MINERSOL: R; Inertial: I; Non-Inertial: H) and Data Basis more or less Reduced (measurements every minute or each 6, 30, 60 minutes; Cumulative Frequencies Curves;...) for two locations of the Parisian Region (Le Landy and Trappes).

40151 (EUR-11062) **Solar-heated swimming-pool in Horsens, Denmark demonstration project.** Esbensen, T.; Nielsen, C. Commission of the European Communities, Luxembourg (Luxembourg). 1987. 38p. Available from NTIS (US Sales Only), PC A03/MF A01.

The swimming-pool in Horsens is equipped with a combined solar system (300 m^2 of flat-plate unglazed absorbers), a water-to-water heat pump system (70 kW) and a centralized control and supervision system. The plant has been in operation since 1983 and has given satisfactory results. In 1983 and 1985 the total absorber output was 414 kWh/m^2 for the whole year and 250 kWh/m^2 for the summer season. The simple pay-back period of the plant is 15 years.

40152 (STU-85-4187) **Solar collector Suntherm. Laboratory test. Full scale test for preheating of ventilation air in a building for piglets.** Gustafsson, G.; Hedstroem, R. Swedish National Board for Technical Development, Stockholm (Sweden). 30 Jun 1988. 116p. (In Swedish). Order Number DE89902433/JAW. Available from NTIS (US Sales Only), PC A06.

A test of the solar collector 'SUNTHERM' has been performed. The solar collector has a suspended, permeable absorber covered with a corrugated plastic sheet. In the laboratory the momentary efficiency was measured when solar radiation exceeded 630 W/m^2. At specific air flows greater than 0.01 $m^3/(m^2\ s)$, the upper absorber surface of the solar collector had the same temperature as the exhaust air. The air temperature in the exhaust air duct of the solar collector can therefore be controlled which means that conduction losses through the covering can be minimized. The effective heat transfer coefficient of the device was 17.3 W/(m^2k). A field study was made of a SUNTHERM heating device installed at a farm in southern Sweden. The area of the solar collector was 40 m^2. It was placed on the south gablewall of a pig house. It was used to preheat ventilation air. The energy supply from the collector during the test period, was about 1 300 kWh. The average efficiency of the device for the whole period was about 21 %. Some defects in the device were observed during the test period including some design errors. By correcting these errors it should be possible to increase the efficiency of the system to 25 to 30 %.

1410 Solar Collectors and Concentrators

Refer also to citation(s) 40132, 40149, 40150, 40151, 40154

1420 Heat Storage

Refer also to citation(s) 40149, 40320, 40395

40153 (BFR-R-6-1989) **Follow-up of operation. Heating and cooling system with aquifer storage at Kristianstad.** Kronqvist, L.; Simonsson, R. Swedish Council for Building Research, Stockholm (Sweden). Dec 1987. 38p. (In Swedish). Order Number

DE89902426/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Follow-up of the functioning of an aquifer thermal storage was done. The energy store was a part of a heat pump installation for both cooling of an industrial process and heating of the factory building. The object of the project was to collect operation data from the ground water system and then explain the thermohydraulic behaviour of the energy store. The result after 1 year's follow-up shows that a considerable energy excess has been stored in the aquifer, resulting in an increasing output temperature. The cooling by means of ground water was thus impeded. By drawing off energy during 1987 a lower ground water temperature was attained. A computer model was set up and calibrated against measured conditions. The model was then applied to calculation of temperatures at a more balanced condition of storage and withdrawal of energy, and, in one instance, with a considerably higher withdrawal than storage. Recommendations are given for continued operation of the plant.

40154 (ITL–8509, pp. 504-507) **Simulation and experiments in moderate climate conditions on the behaviour of greenhouses, fitted out with a short-term rock-bed thermal storage.** Van Loey, J. (Vrije Univ. Brussel, Brussels, Belgium); Van de Perre, R.; Leskens, E. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In moderate climate-zones, it is quite illogical that during daytime, greenhouses have to be ventilated, only to lose their excess of accumulated heat, while during nighttime fossil energy is needed for the same greenhouse to fulfil its energy requirements. A solar retrofit for existing greenhouses is presented. The solar system, developed for horticultural applications in a moderate climate, is also appropriate for the housing sector, new built greenhouses and for other climate zones. A full year measurement compaign in 1983 indicated an energy saving of an annual basis of 70%, for the culture of grapes and vegetables in Belgium. The solar system consists of a self-made flat plate air-collector in the ridge of the greenhouse, connected to a pebble-bed placed in the soil, through a regulation and air-distribution system (including flow inversion in the storage). Advantages of this solar system are its simplicity, its efficiency and its cost-effectiveness, which are all proven experimentally. A numerical model has been elaborated to determine the optimum configuration of the system for given comfort and climate conditions. 2 refs., 2 figs.

15 GEOTHERMAL ENERGY

40155 (ETSU-R–46) **1987/88 geothermal HDR programme review.** Taylor, R.J. UKAEA Harwell Lab. (UK). Energy Technology Div. Mar 1988. 90p. Order Number DE89790668/JAW. Available from British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks., LS23 7BQ.

A review is presented of the UK Geothermal 26th Dry Rock (HDR) Programme at the Cambourne School of Mines. Recent appraisals of the size of the HDR resource and assessments of the current status of HDR technology have led to economic and drilling depth constraints which present considerable engineering difficulties requiring solution before any commercial involvement will occur. A strategy for the future development of the HDR program is advocated which addresses the main technical problems.

1501 Resource Status and Assessment

Refer also to citation(s) 39807

40156 (EUR–10281) **Experimental determination of the speed of flow in the geothermal Dogger aquifer of the Paris basin.** Anon. Commission of the European Communities, Luxembourg (Luxembourg). 1985. 61p. (In French). Available from NTIS (US Sales Only), PC A04/MF A01.

This document synthetizes the results obtained on the determination of the hydrothermal properties of the geothermal aquifer of the Dogger, in the Paris basin (France). The main emphasis was put into the determination of the natural velocity of the water in the Dogger. Two methods of measurements were used, one based on the in situ dilution of a radioactive tracer in the well with time, the other on the calculation of the velocity from the permeability and the pressure gradients measured at the bottom of the wells. A detailed thermal logging of the Dogger reservoir was also used for the interpretation of the results. This series of measurements was made initially in Fontainebleau, and then repeated on two additional wells in Cachan. They provide a coherent picture of the velocity in the aquifer. The main conclusions are that it is no longer possible to consider the natural velocity in this aquifer as negligible, as was done so far.

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 39807

40157 (CRIE–U-87067) **Development of geothermal hot water simulation. Simplicity estimated method of geothermal reservoir.** Motojima, Isao; Nakagawa, Kameichiro; Komada, Hiroya. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 37p. (In Japanese). Order Number DE89760367/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

At the preliminary stage of geothermal development, by seizing the outline of underground geothermal structure (depth, width and temperature of heat source) and evaluating the influence, etc. on the geothermal source in the vicinity, to be utilized by the hot spring and other existing facilities, a simplified underground geothermal structure evaluating simulation method, for the purpose of discussing its possibility, was developed by using a finite element method. By designing a model, where natural water on the ground surface, having flowed down and been heated by the geothermal source, flows up again in the ground by the convection, the flow was assumed to be under Darcy's equation, with the equilibrium condition assumed between geothermal water and porous layer. As a result of comparing that method with the most appropriate existing model, both the method and model coincided with each other in both the welling out quantity and range of hot spring water, which confirmed its applicability. However, it resulted in a slight difference in flowing condition and temperature distribution of hot water. It is judged to be attributable to the fact that, against the existing model being an axial symmetric model, that method modelwise is a vertical two-dimensional model. 4 references, 7 figures, 7 tables.

16 TIDAL AND WAVE POWER

1605 Environmental Aspects

40158 (CRIE–U-88012) **Investigation on types and characteristics of recent breakwaters and seawalls.** Abe, Nobuyuki; Kajima, Ryoichi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Sep 1988. 96p. (In Japanese). Order Number DE89772346/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In recent years, breakwaters and seawalls have came to be considerated not only as the protective structures against waves, but also as the structures with various additional functions which are in agreement with the local requirements. Also the breakwaters and seawalls for large coal power plants and artificial islands, which are located in the area with more severe wave conditions in deeper water, have a tendency to be requested more economical structures. From these points of view, functions and structural type and form of representative 45 cases of breakwaters and seawalls, which were

constructed at major harbors in Japan from 1972 to 1983, were investigated. It was concluded that the caisson type steuctures are easy to add various secondary functions and more economical for higher wave conditions in deeper water. A developed CRIEPI (Central Reseach Institute of Electric Power Industry) type breakwater becomes more economical to the construction of breakwaters in deeper water above 20 meters, and suit to seawalls which are required seriously more effective function of wave protection because of less overflows, and also suit to breakwaters as maritime facilities located adjacent to a fishery harbor because of lower refraction. 11 references, 6 figures, 49 tables.

17 WIND ENERGY

Refer also to citation(s) 40331

1703 Regulations

40159 (ECN–89-103) **Recommendations for a European wind turbine standard on performance determination.** Curvers, A.P.W.M.; Pedersen, T.F. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1989. 4p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Paper presented at the European wind energy conference (EWEC '89), Glasgow, UK, 10-13 July 1989.

Within the framework of a uniform development of licensing criteria and certification procedures for wind turbines within the European Communities, CEC has commissioned a contract to a group of European wind turbine test stations (ECN, Risoe, CWD, NEL, VUB, WISA) to set-up a set of recommendations for a European wind turbine standard on performance determination. The present recommendations are based on the established experiences of the test stations involved, on existing standards (IEA, AWEA, CSA) and on a CEC study on accuracy of power curve measurements. In comparison with the existing standards the most important differences are: the total measurement time is proposed to be dependent on a minimum number of data sets per bin and a 1% statistical uncertainty in the annual energy output due to wind variability; the required accuracies of the measurement instrumentation and signal conditioning have been strengthened; it has been recommended to apply different correction procedures on air density variation, for stall regulated and pitch regulated wind turbines; and, the analyses of instrument uncertainties and statistical error due to wind variability have been adopted in the recommendations. The testing procedure has been adjusted to the above mentioned changes. 15 refs.

1705 Environmental Aspects

Refer also to citation(s) 40161

1706 Wind Energy Engineering

40160 (DFVLR-Mitt.–88-31) **Type-specific dynamic measurements on wind turbines at the test site Schnittlingen. Final report.** Boehnisch, H.; Kussmann, A.; Thiesen, R.; Reiniger, K. Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). 23 Dec 1988. 102p. (In German). Contract BMFT 03E-8156-A. Order Number DE89794862/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A06/MF A01.

The German Aerospace Research Establishment operates the test site 'Ulrich Huetter' for small and medium sized WECs since 1979. Tests have been performed on several industrial machines of different design within the scope of a government-financed research programme, supported by the Federal Minister for Research and Technology. For recording high dynamical data from the rotating system, two telemetry PCM systems are used. The data of high-speed short-term measurement campaigns and of the long-time measurements are preprocessed on the test site process computers for averaging and first verification. Final evaluation of the data is done off-line on the DFVLR main frame computers. A subject of special interest are weather conditions. Particularly their influence on the behaviour of the control system and on the performance of WECs is studied. In this report, typical analysed data of the tested WECs and interesting weather conditions are presented. A list of experiences and recommendations on wind test work is given as conclusive results. (orig.) With 20 refs., 71 figs.

40161 (ECN–89-100) **Acoustic noise measurements on wind turbines.** Van der Borg, N.J.C.M.; Stam, W.J. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1989. 5p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Paper presented at the European wind energy conference (EWEC '89), Glasgow, UK, 10-13 July 1989.

The acoustic noise emitted by wind turbines can be a serious obstacle for the realisation of wind energy projects. This is especially the case in countries with a high population density like the Netherlands. For this reason the acoustic noise emission of wind turbines is an important item for the manufacturers of turbines (who want to minimize the emission) and for the licensing authorities (who want to predict the noise immission of the turbine at a certain distance). The noise emission can be characterised by performing acoustic noise measurements in the vicinity of the wind turbine according to recommended practices. At the moment three documents are available describing recommended practices for the measurement of wind turbine noise. These documents are compared. ECN has performed acoustic noise measurements on wind turbines since 1982. Due to the increased importance of wind turbine noise the measurement procedure and data treatment has been modified substantially. The new procedure is described, together with some examples of measurement results. A list of measured acoustic source power data of various wind turbines has been obtained from measurements by ECN and from the open literature. Using these data an empirical relation has been calculated between the source power and the rotor diameter of the wind turbines. The source power data and the empirical relation are given. 6 figs., 36 refs., 1 tab.

40162 (ECN–89-107) **Fatigue and turbulence associated wind gust modelling for rigid medium size wind turbines.** Oei, T.D. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1989. 6p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Paper presented at the European wind energy conference (EWEC '89), Glasgow, UK, 10-13 July 1989.

Accurate meteorological wind data are essential for the determination of the dynamic loads of wind turbines. However, these data need further mathematical elaboration in order to be useful for such analysis. The frequency spectra of wind speed fluctuations, averaged over the rotor area, yield detailed frequency information of the coherent speed variations within the swept area, which is called the 0P-mode. The load variations of the rotating blade also contain higher mode variations than the blades, while in motion cut into turbulent air 'bubbles' of finite dimensions. These higher mode variations may be responsible for undue fatigue failure. The calculation of the power spectrum of the load variations of the rotating blade has been done elsewhere. Wind gust modelling is made complicated by the phenomena described above. Not only does the multimode behavior complicate the modelling, also the wide band nature of the speed variation of the 0P-mode, requires careful statistical analysis if the gusts are to be presented by a narrow band process. The higher mode fluctuations of the wind speed are already narrow band in nature due to rotation. Fatigue life prediction, such as from rainflow counting, needs a time history of the varying load. Wind gust models become arbitrary when no criterion whatsoever underlies the determination of the amplitude and period of the gust. An objective criterion for finding the amplitude of the gust has to be obtained from the requirement that the damage rate is correctly calculated. The period of the 0P-mode gust is obtained from the upcrossing rate and is calculated using Rice's formulas. This period, once the turbine size and tower height are determined and turbine site is specified, is only dependent on a single dimensionless quantity, called the reduced coherence coefficient. 5 figs., 9 refs., 3 tabs.

40163 (SERI/STR–217-3405) **The dynamic response of a Westinghouse 600-kW wind turbine.** Snow, A.L.; Heberling, C.F. II; Van Bibber, L.E. Solar Energy Research Inst., Golden, CO

(USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div. Mar 1989. 54p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093;FC02-86CH10296. Order Number DE89000900/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This report is the seventh in a series of documents that present the findings of field tests conducted under the Department of Energy's Cooperative Field Test Program with the US wind energy industry. In the field tests described in this report, a 600-kW wind turbine located on the north shore of the island of Oahu, Hawaii, was used to sample the loads and performance of an intermediate-size wind turbine. This report documents the instrumentation, data acquisition system, data-gathering periods, calibration, and the initial assessment of the data. These data can be used to validate aeroelastic design methods for predicting service loadings of intermediate-size, upwind, teetered-hub, horizontal-axis wind turbines. In spite of some data limitations, the report contains useful insights into the dynamic operating performance of the test turbine. 5 refs., 35 figs., 10 tabs.

40164 (STEV-VIND–89-1) **Control of current converter for a wind power plant with variable number of revolutions.** Alatalo, M. Statens Energiverk, Stockholm (Sweden). Jan 1989. 36p. (In Swedish). Order Number DE89902463/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report describes control of a converter that shall be used for controlling the rotational speed of a wind-power mill. Mainly the report deals with the problem of controlling the converter that is connected to the public electrical grid. This converter is a six-pulse converter that is equipped with power transistors. Two different methods of control are compared to each other. The comparison has been made using a package for simulating differential equations, the package is called SANDYS. (author).

40165 (STEV-VIND–89-10) **Preparatory study of permanent magnet synchronous generators for wind power plants.** Alatalo, M. Statens Energiverk, Stockholm (Sweden). 1988. 44p. (In Swedish). Order Number DE89902464/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

It is possible to construct windpower mills equipped with low-speed and low-weight machines using unconventional types of machines and permanent magnet materials as NdBFe. The report presents different problems concerning synchronous generators and their use in windpower mills. An interesting approach is using permanent magnet materials in the rotor of the machine to establish a magnetic flux. According to an estimation it is possible to decrease the generator size and weight when the rotor is constructed as a disk. (author).

40166 (STEV-VIND–89-12) **Blade root design a state of the art survey.** Sandberg, O. Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). Jun 1988. 22p. (FFAP–201). Order Number DE89902466/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This report was conceived in the wake of recent blade root failures in several horizontal axis turbines. Ten blade root designs are presented. They are considered to represent the state of the art. The information was obtained partly from literature partly from a few important projects with little or no documentation. Suggestions are made how to proceed in the development of the bonded bolt type of root retention. Presently the conclusion is that this type of arrangement seems the most promising. Developments in this field should be closely monitored, however. For this type of very high cycle fatigue designs there is a need for two redundant design principles. (author).

20 ELECTRIC POWER ENGINEERING

40167 (SV-UE–1988-47) **SYNTRA. A program for studies of electrical machines and their control systems during transient conditions.** Langer, P. Swedish State Power Board, Vaellingby (Sweden). 27 Sep 1988. 197p. (In Swedish). Order Number DE89902437/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

SYNTRA is a simulation program. Electrical machines and their control systems can be studied during transient conditions. Below are given some samples on studies that can be solved with the aid of SYNTRA: * Current and torques resulting from momentary faults, * Analysis of shaft systems. Calculating shaft torques during disturbances, * Stresses at faulty synchronisation, * Static stability including the influence of excitation systems and power system stabilizers, * Out of step operation. Analysis of asynchronous performance, * Transient stability including the influence of excitation systems, * Subsynchronous resonance, * Start of asynchronous machines with and without Eddy current rotors, * Connecting asynchronous machines with thyristor couplers, * Governor control systems, * Influence of saturation on transient behavior, * Optimizing control systems including limiters, * Specifying the operating characteristics of relays, * Coordination with DC-links. In Instructions and Explanations the theoretical background for the program SYNTRA is given. A number of samples on performed studies and the appendix gives additional information on how to use SYNTRA and its auxiliary programs PLOTTS and TORBOANA. SYNTRA provides a fast and simple way to study even complex problems involving electrical machines. (author).

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Refer also to citation(s) 39869, 39881, 39894, 39904, 40142, 40165, 40234, 40343, 40369, 40378, 40424, 40426, 40446, 40447

40168 (CONF-890616–1) **The enhancement of the salt simulation and analysis code for first-and second-law analysis.** Rosen, M.A.; Berry, G.F. Argonne National Lab., IL (USA). [1989]. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From International symposium on thermodynamic analysis and improvement of energy systems; Beijing (China); 5-8 Jun 1989. Order Number DE89015704/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The enhancement for First- and Second-Law analysis of the SALT (Systems Analysis Language Translator) simulation and analysis code, developed at Argonne National Laboratory, is described. The enhancements involved the development of three SALT models. The principal model, EXG, is a post-processor which calculates parameters required for First- and Second-Law analyses, and prints output summaries. The secondary models, EXRG and EXRF, are used to supplement the results provided by EXG when specific systems-analysis tasks are being performed. The models can be used to evaluate (1) flow rates of the components of energy and exergy, of total energy and exergy, of entropy and of energy associated with the lower and higher heating values, and the contributions of the species present to chemical energy and exergy (for material, heat and work flows, where appropriate); and (2) rates of entropy creation and exergy consumption, and values of several First- and Second-Law efficiencies, in any component or group of components. The models require as user input the temperature, the pressure and the composition of the reference environment; the chemical-exergy evaluation methods used; and the temperatures associated with heat transfers. As an illustrative example, an elementary coal-fired steam power plant is analyzed with the enhanced code. 18 refs., 4 figs., 6 tabs.

40169 (CRIE–T-87108) **Concept design of a catalytic combustor for gas turbines.** Fukuzawa, Hisashi; Ozawa, Yasushi; Mandai, Shigehiro; Gora, Tetsuo. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 27p. (In Japanese). Order Number DE89760358/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

The applicability of catalytic combustion technology, to the LNG combined cycle power generation gas turbine combustor, is discussed. It is a NO/x decreasing technology, using a fuel/air premixer, by a high performance Pd system catalyst and multi tube venturi system. A 1,300°C x 100MW class combustor was conceptually designed. It is dimensionally installable within a space for the ordinary gas turbine combustor. To be able to correspond to the wide range load, the compressor air inlet and tail pipe parts were provided with inlet air guide vanes (IGV) and by-pass air guide vanes (for supply to combustor), respectively, for the air flow rate

adjustment purpose. It was considerably amplified, to 26 through 94%, in load range where the catalytic combustion is possible. An afterburner is simultaneously used at 95 to 100% of nominal load. An excellent performance can be in expectation, with superiority to 99.8% of cumbustion efficiency, 10 ppM of NO/NOx and 5% of total pressure loss. The applicability of thus conceptually designed catalytic combustor to the large gas turbine came to be expected. 4 references, 20 figures, 5 tables.

40170 (CRIE–T-87111) **Water-cooling technique of high temperature gas turbine blade Verification of analysis cord and investigation of the arrangement of cooling holes.** Sakuma, Toshio; Tashiro, Hisao; Araseki, Hideo. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 30p. (In Japanese). Order Number DE89760375/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

A new water cooled bucket technique which was installed concentric tubes as coolant passages was proposed to solve the problems on a water-cooling of gas turbine blades, and has investigated the basic characteristics of cooling performance. And the prospects for the water-cooling technique were obtained. Thereupon, for the purpose of concreting the possibility of putting this technique to practical use and providing basic data for design, the verification of the analytical model of blade, which is equipped with internal water-cooling system, was carried out through the experiment under the conditions of combustion gas. Furthermore, the cooling structure was studied through the numerical analysis and the experiments. As the result, the analysis cord with high precision was obtained from the comparison of the numerical simulation and the experimental result. It was found that the blade temperature and thermal stress can be maintained at sufficiently lower level against the gas temperature of 1,500°C by the application of the proposed cooling structure. 6 references, 24 figures, 4 tables.

40171 (CRIE–U-87030) **Field observation of the wave deformation on the elliptic shoal.** Hirakuchi, Hiromaru; Maruyama, Koki; Kajima, Ryoichi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 59p. (In Japanese). Order Number DE89772348/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In order to economically design breakwaters and seawalls for a seaside power plant, it is necessary to evaluate influences on the irregular wave deformation by a bottom topography. In this paper, the irregular wave deformation in the stormy weather in the field on such an elliptic shoal was observed using wave gauges and current meters, the wave heights, wave periods, wave mean directions and directional wave spectra were analyzed from these data. As a observation result, these space and time characteristic values of the wave field had large fluctuations to determine the wave field characteristics with difficulty, but the increasing rate of wave height by wave ray crossing on the shoal was found to be about 1.2 times wave height in the offing in the case of wind waves, and 1.4 times in the case of swell. Using the observation results at six kilometers off shore as boundary conditions, the wave deformation was calculated with a developed numerical calculation method which is based on the conservation equation for energy flux. Characteristics of the wind wave field could be estimated with this numerical model in the good agreement of obserbation results. But for the swell field it was important to evaluate the refraction-diffraction effect near a caustic. 19 references, 29 figures, 5 tables.

40172 (CRIE–U-87075) **Study on the application of roller-compacted concrete method to the electric-power-related mass concrete structures (Part 4). Examination of compactibility of RCC by vibrating table.** Kato, Osamu; Kawasumi, Makoto; Endo, Takao; Aoyagi, Yukio; Kasahara, Kiyoshi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jun 1988. 74p. (In Japanese). Order Number DE89760366/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

As a series of lowering measures in construction cost, for the purpose of putting the RCC work method to practical use, in the construction of concrete foundation in thermal and nuclear power stations, artificial rock bed, dam, etc., the influence of amplitude and acceleration, on the compacted RCC formation, was discussed. In the present test, RCC, confined in a cylindrical vessel, was vertically vibrated by a vibration table and measured in secular change in subsidence. To approximate the subsiding formation of RCC, an analytical method, capable of easily assuming the subsidence, if RCC before compacted was measured in air quantity, density, etc., was derived. In case that the maximum kinetic energy (EK) per unit volume was smaller than approx. 1,000 erg/cm^3, the subsidence speed was proportional to EK. Otherwise, it was constant. EK, important parameter to determine the subsidence condition, was understood to be able to evaluate the effect of vibration in the compacting. For the quality control purpose, it is appropriate to fix the standard value of EK to be 800 erg/cm^3. 8 references, 33 figures, 9 tables.

40173 (CRIE–W-87014) **Demonstration of on-line display system on combined-cycle power plant operation.** Mimaki, Toshio; Hamamatsu, Teruhide. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jun 1988. 29p. (In Japanese). Order Number DE89760381/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

As a series of high efficiency gas turbine research and development tests, aiming at the combined cycle entire heat efficiency, superior to 55%, a 1,300°C (at the inlet) x 100MW class gas turbine pilot plant was operationally tested during 1984 through 1987. To develop the test data as a basis and calculated, on line, the entire heat efficiency as a combined power plant, a combined cycle power plant operation on-line display system was developed and operationally demonstrated. That system, simultaneously with collecting/recording the operational data, simulates, in operational condition, the exhaust heat recovery boiler and steam turbine, to display them on a large scope board. Based on 60 operational data collected/recorded on the pilot plant during 1 second of sampling, the simulation and on-line display of exhaust heat recovery plant, during the time that the gas turbine generator was paralleled on through off the system, were made and satisfactorily operated. The arithmetic processing could be stably executed in 21 to 25 seconds. It is widely applicable to the performance surveillance, degradation diagnosis, etc. in the actual power plant. 7 references, 12 figures, 7 tables.

40174 (CRIE–W-87039) **Development of an expert system supporting short-circuit tests for circuit breakers.** Sunabe, Kinya; Horiuchi, Ryuzo. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jun 1988. 74p. (In Japanese). Order Number DE89760384/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

Test operator must be familiar with electrical and mechanical characteristics on the many and complicated equipments to operate the large capacity short-circuit ones. The expert system supporting short-circuit test for circuit-breaker was developed to reduce the burden and to make unskilled workers operatable in a short period. A personal computer is operated by using expert system program language and C-language. This system can be used by operating keys except character ones to improve man-machine interface. The suitable testing circuit is selected and circuit constant to be inserted is presented to operate the system. The setting times for sequence timer and phase controller are calculated and presented. Optimal instruments are designated and presented on the basis of measuring items such as voltage and current. The calculated results by this system agreed well with the previous manual calculations by the comparison with the setting values for the conventional automatic analyser of measurements. Anyone can carry out the short circuit test of circuit breaker rightly, easily and safely without complicated manual calculation. 4 references, 17 figures, 15 tables.

40175 (CRIE–Y-88011) **Survey of dynamic operating costs analysis.** Kiyono, Keiko. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Oct 1988. 43p. (In Japanese). Order Number DE89760422/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In order to maintain high quality of electric power, the power suppliers must respond quickly to variations of load of customer by changing the output. However, it cause lowering operating-efficiency of the power generation system, and increase of the operating costs

which are called dynamic operating costs (DOC) occur. To reduce the operating costs effectively, the concept of DOC and the conventional analytical method were studied. DOC become greater as electric load changes more quickly. And the faster the follow-up speed of the plant, the smaller the DOC. If energy storage technology is introduced to meet the load change, a large amount of DOC could be saved due to the following reasons : (1) economical load-distribution among the thermal power plants; (2) to make plants operate at near full capacity with high efficiency; (3) reduction of thermal plants' DSS (Daily Start and Stop) losses; and, (4) to reduce the cycling units' operation which needs high fuel costs. At the present time, characteristics of the thermal plants and the energy storage plants can be simulated in detail. A sharp cut of DOC can be performed through the improvements on the load follow-up speed and the range of follow-up. 11 references, 17 figures, 11 tables.

40176 (EPRI-GS–6397) **Operating problems with startup valves in US and Japanese supercritical steam generators: Topical report.** Fitzgerald, F.D.; Tsao, D.; Saito, T. Electric Power Research Inst., Palo Alto, CA (USA). Generation and Storage Div.; Foster Wheeler Energy Corp., Livingston, NJ (USA); Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan); Bailey Japan Co. Ltd., Shizuoka (Japan). c Jul 1989. 95p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The evolution of the boiler start-up systems for once-through units (OTUs) in the United States is outlined. The service requirements for the control valves of a generic flash tank-based start-up system are described. "Control-Valve Problem Questionnaires" were prepared and distributed to operators of OTUs in the United States of America and Japan. The results from the questionnaires are presented for the superheater bypass, furnace outlet throttling, and turbine bypass control valves. The minutes of interviews with two US boiler manufacturers and four utility operators of OTUs are presented. The topic of discussion was OTU control valve problems and solutions. A summary of control valve problems at OTUs in Japan is presented. A distinction is made between base-loaded OTUs and the new cycling OTUs. Factors influencing the decision to replace original control valves with modern valves are summarized. 8 refs., 19 figs., 12 tabs.

40177 (INIS-mf–11985, pp. 101-112) **High temperature strain measurements on discs and blades of gas turbine rotors during test bed tests.** Boehm, W. (Siemens A.G. Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.)); Terjung, K. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). (CONF-8709343–: 4. safety colloquium on explosion protection, Braunschweig (Germany, F.R.), 9-10 Sep 1987). In *Strain measurement technique. Practical applications under specific boundary conditions for enhancing plant safety and availability. Proceedings.* Order Number DE89794896/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01.

During test bed tests of a single shaft rotor of a 105 MW gas turbine in working conditions, the stresses on the components are measured, in order to obtain comparative parameters for the calculations and to guarantee safe operation. These measurements are mainly taken by high temperature strain gauges. The measured values are transmitted via telemetering systems and multi-pole slip rings. From the measurements, the dependence of inherent frequencies on centrifugal force and the strain at discrete points of the components can be determined. The results of the static strains at the discs and the alternating strains at the turbine blades are explained, with short examples. (orig./DG).

40178 (LUTMDN-TMVK–5175-1-54-1989) **Mapping of functional trouble in large turbine plants.** Wallheden, L. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Feb 1989. 57p. (In Swedish). Order Number DE89902443/JAW. Available from NTIS (US Sales Only), PC A04.

Examination paper.

This report only treats disturbances 1985-1988 in Finnish and Swedish nuclear power plants. The study starts out from the power plant monthly reports, supplemented with different types of operation reports. The disturbances are classified according to the initial event in a mapping of the different systems of the plant. The compilation of data shows that the most common disturbances resulting in production drop are caused by the control oil system, followed by turbine, feed water system, intermediate reheating system, turbine regulator and condensate system. Most disturbance occasions have involved smaller power reductions, caused by function impeding or component faults. This is particularly valid for pneumatic valves and pumps. The problems put stress on maintenance rather than operation. The report illustrates consequences of leakage in bleeding pipes, condenser tubes, intermediate reheaters, high-pressure preheaters and low-pressure preheaters.

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Refer also to citation(s) 39847, 39848, 39849, 39856, 40158, 40171, 40378

2003 Power Transmission and Distribution

Refer also to citation(s) 40174, 40317

40179 (CRIE–T-87063) **Experimental study of shielding against lightning in winter season (Part 3).** Aihara, Yoshinori; Shindo, Takatoshi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 35p. (In Japanese). Order Number DE89760356/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

The shielding effects under DC voltage electric field or ion flow field have been studied on the assumption that transmission lines or high strutures are shielded from lightning by lightning conductor towers under uniform thunder cloud. The shielding characteristics under DC voltage or impulse voltage superimposed on DC voltage are clarified as follows; (1) In the arrangement with shielding high structures by lightning conductor towers, the shielding effect is equal to that under impulse voltage only. (2) In the arrangement with shielding transmission lines by lightning conductor towers, the dispersion of the effect is larger than that under impulse voltage only, the flashover probabilities of line tend to be lowered. (3) steady ion flows of positive or negative polarity do not affect the shielding characteristics very much. Furthermore, on the shielding characteristics under DC voltage only, the flashover probability to a shielding subject is lowered than that under impulse voltage only. 7 references, 20 figures, 4 tables.

40180 (CRIE–T-87064) **Development of detecting method using magnetic field sensor for bad contact parts in GIS.** Fujinami, Hideo; Takuma, Tadashi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 25p. (In Japanese). Order Number DE89760355/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In gas insulated switchgears, switches such as a breaker, disconnector and a contact portion between conductors like a connection point of bus bar are installed in the enclosure. It is impossible to observe internal equipments from outside. A new diagnostic technique of bad contact condition which is one of accident factors of gas insulated equipments was studied. The principle is to measure the magnetic field caused by the current distribution at a bad contact point from outside the enclosure. The experimental results for artificial bad contact conditions are as follows. In the case of alminum enclosure, variation of conductor current distribution due to a bad contact condition can be detected by an optical magnetic field sensor attached on the outside surface of an enclosure. In the case of iron enclosure, the field variation is so small outside the enclosure that it is necessary to use a sensor with the higher sensitivity or install a sensor inside the enclosure. The method is effective measure for regular monitoring and diagnosis in practical use. 5 references, 20 figures, 3 tables.

40181 (CRIE–T-87065) **AC withstand voltage characteristics of snow covered insulator strings.** Imano, Yoshio; Takasu, Kazuhiko; Kato, Masao; Sunaga, Masami. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 49p. (In Japanese). Order Number DE89760354/JAW. Available from NTIS (US

Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo,Japan.

At a heavy snowfall area, snow covering on insulator strings is developed and results in decreasing the withstand voltage of insulator strings owing to the conditions of snow covering and snow quality. The snow covering may become a dominant factor for insulation design of UHV AC power transmission lines which are expected to lay at inland snowfall area. The voltage application test with naturally snow covering, withstand voltage test with artificially snow covering, and the investigations on the conditions of snow covering under continuous voltage application and the snow quality have been conducted at Nakatsugawa snow testing station (Niigata prefecture) over a period of three years. And the AC withstand voltage characteristics of snow covered insulator strings were studied. The conductivity of water melted from snow at testing station was less than 50 micro S/cm. The height of snow on the energized insulator strings was affected by voltage application and sunshine, and it became lower than that under no voltage condition. The withstand voltage characteristics of natural snow (less than 50 micro S/cm) covering insulator almost agreed with those of artificial snow covering in the evaluation on the volume density of snow. The results are possible to be applied to insulation design at inland snowfall area. 2 references, 40 figures, 5 tables.

40182 (CRIE–T-87078) **Studies on corona and field effects of Shiobara HVDC test line (Part 9). Characteristics of large ion densities.** Suda, Tomotaka; Sunaga, Yoshitaka. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jul 1988. 20p. (In Japanese). Order Number DE89760379/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

The voltage characteristics, lateral profiles and maximum value of large ion densities with particle size of 0.01-0.04 micro m were studied in the Shiobara HVDC test line with ACSR 810mm^2, two-conductors and two-circuits. Applied voltage has a little influence on large ion density. The large ion density increases gradually under the downwind, reaches the maximum value at 60-70m from the line center and then decreases gradually. But it is two - three times larger than its background level (BGL) at a point 200m far from the line. The large ion density under the downwind decreases with exponential function of the distance. Maximum large ion density becomes nearly equal to four times of BGL and occupies about 40% of aerosol density less than 1 micro m diameter. As the ratio of the large ion density correlates with that of small ion, it is considered that the large ion density can be estimated from the natural environmental density of aerosol. 9 references, 12 figures, 4 tables.

40183 (CRIE–T-87082) **Diagnostic method for internal deterioration of epoxy mold spacers used in GIS.** Fujinami, Hideo; Takuma, Tadashi; Kawamoto, Tadashi; Okamoto, Tatsuki. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 30p. (In Japanese). Order Number DE89760360/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

As a part of studies on the diagnostic technique of the internal deterioration in epoxy mold spacer used in gas insulated switchgear, long-term continuous loading experiments have been conducted using model spacers with various defects, and a diagnostic method for internal deterioration through a partial discharge measurement was studied. In the spacer without defect, it appears to be difficult to predict the development of deterioration through the occurrence of a partial discharge, because the breakdown occurs without a precursory phenomenon of insulation deterioration. On the other hand, in case of the spacers with an exfoliation and a void, a partial discharge of 100pC (average) to 1000pC (maximum) occurs, and the breakdown is brought with the lead time of about 100 hours. On the detection sensitivity of detecting sensor for a partial discharge, the sensor with about 100pC sensitivity is developed, which can removes external noises. It is thought that detection of the spacer with defect is possible in principle. 9 references, 17 figures, 7 tables.

40184 (CRIE–T-87083) **Experimental study of shielding against lightning in winter season (Part IV).** Aihara, Yoshinori; Shindo, Takatoshi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 34p. (In Japanese). Order Number DE89760361/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

Lightning conductor tower is used as one of the lightning shields to protect electric power equipments from winter lightning. It is found by the observation of winter lightning that lightning strokes to high constructions are almost occurred at windward side and the angle of discharge path inclines toward the windward. Negative polarity switching impulse was applied to wire net electrode simulating lightning cloud, by supposing that lightning occurrs when lightning cloud is close to high constructions on the basis of previous test results, to examine the lightning shield characteristics of lightning conductor tower. More oblique the discharge path, more difficult to occur the flashover to the grounding electrode. The calculation method estimating the relation between lightning cloud location and shielding rate of lightning conductor tower was introduced for two rod electrodes with different discharge angles on the basis of previously established emperical formula, indicating that the actual lightning stroke rate by winter lightning observation agreed well with the calculation. 6 references, 17 figures, 2 tables.

40185 (CRIE–T-87087) **Computation method of ion flow field around HVDC transmission lines.** Sunaga, Yoshitaka; Amano, Yuji. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Sep 1988. 43p. (In Japanese). Order Number DE89772351/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

A new computational analysis to predict the ion flow electrification, atmospheric ions, electric field and other electric environments, under the HVDC transmission line, was developed. It is a finite element method, to compute the ion flow electric field in the presence of wind, based on the electric force lines and potential distribution, in case there exist no ions. The configuration proper of element nearly coincides with the electric field and current distributions, which improves it in accuracy. Particularly on the surface of transmission line, by the heightening in computing accuracy, the supposition that the current density of ions, generated from on the surface of transmission line, be determined by the electric field on that surface, becomes usable for the predicting computation, without using the corona current and other measured values. While by the automatic element division, the computation can be made, only if the line distribution and potential are given. For the coaxial cylinder distribution, the computation was discussed in accuracy. The error in electric potential and field computation was at the same level as that in the past or 1/3. The error in computation of electrec field on the transmission line surface and corona current is less than 0.5%. Also, the change in ion flow distribution by wind could well reappear. Under a four-conductor two-circuit test transmission line, the electric field and ion density coincided in computation and measurement. 28 references, 18 figures, 1 table.

40186 (CRIE–T-87101) **Security control of bulk power system. Fundamental consideration on the application of autonomous decentralization system.** Takahashi, Kazuhiro; Kawai, Yoichi; Tsuboi, Akira; Uchida, Naoyuki; Tanaka, Kazuyuki; Nanahara, Toshiya; Taniguchi, Hiroto; Kameda, Hidenobu; Serizawa, Yoshitsumi; Kurono, Masahiro. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 63p. (In Japanese). Order Number DE89772352/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In order to make up the weak points in future bulk power system, two proposals were made on the configurations of future control system. Main features of the new concept are as follow. (1) Implementation of online security control. To protect on outbreak of a large failure, preventive controls in normal operation are conducted through regular online monitoring and predicton. In an emergency, instantaneous control of the power source is performed to protect extension of the emergency. Furthermore, in a power failure area, quick recovery of the condition is implemented through release control such as system parallel-operation. (2) Realization of security

control as decentralized automonouse system. In conventional hierarchical centralized system, an excessive concentration of the control data may be taken place, consequently decentralization of the system is effective measures. And the application of autonomous decentralization system is most desirable. 21 references, 25 figures, 13 tables.

40187 (CRIE–T-87107) **Characteristics of AC superconducting coils (2). AC losses.** Akita, Shige; Ishikawa, Tadao. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 43p. (In Japanese). Order Number DE89760357/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Eiectric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In order to apply widely the superconductivity technology to electric power equipments, the development and evaluation on the AC superconducting cables have been conducted in the Central Research Institute of Electric Power Industry. The superconducting coils using niobium titanium AC superconducting cables were made by way of trial. The results on AC losses were as follows: AC losses of the superconducting coils at the rated capacities of 500 kVA and 20 kVA were smaller than 0.01%. It was shown that AC loss of unit length of superconducting wire under AC magnetic field having constant strength and frequency can be calculated from measured coil losses. AC losses of AC superconducting wire are smaller than copper wire's Joule loss under magnetic field bellow 0.5T, even though the efficiency of a helium cryogenic refrigerator is considered. However, in order to use under magnetic field of about 2T such as cavity armature of a generator, greater lowering of the loss of AC superconducting wire is required. 8 references, 14 figures, 2 tables.

40188 (CRIE–T-87114) **PWR plant model for long-term power system dynamics analysis.** Inoue, Toshio; Ichikawa, Takeyoshi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jul 1988. 19p. (In Japanese). Order Number DE89760359/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

Conventional model of PWR plants which is valid for up to ten seconds after power system faults was improved to analyze plant response under large deviation of power system frequency and/or voltage during a few minutes after power system faults. When pressure change is calculated for turbine governor valve operation, flashing of holding water in steam generator and steam condensation have the effect to alleviate the pressure change. The model was improved so as to calculate precisely the pressure change in steam generator and reactor coolant temperature change by considering these effects. One of the reactor protection control is based on the pressurizer pressure and reactor coolant temperature, so that the model was also improved to calculate precisely the pressurizer pressure. The system frequency deviation affects on the reactor coolant temperature by changing the reactor coolant pump revolution and flow rate. It was verified that the the change of reactor coolant temperature can be precisely calculated by the conventional flow rate model. The improved model could well simulate the practical response after the system separation. 2 references, 5 figures.

40189 (CRIE–T-88001) **Negative damping oscillation and its countermeasure in a longitudinal power system. Effect of AVR and PSS.** Yoshida, Tadami; Uchida, Naoyuki. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 37p. (In Japanese). Order Number DE89760377/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

It was clarified that the exitation control system has a close relationship to the negative damping long-period oscillation through the analyses on the mode shape of the negative damping oscillation in a longitudinal power system. Moreover, a new method of PSS design was proposed, and its stabilizing effect was studied. Basic mode shapes and nature of such oscillations in the longitudinal power system were shown by the analyses results obtained through S matrix method which is a analytical method for steady state stability. The existence of the peak phenomenon was clarified where the negative damping become worse abruptly in the case the specified parameter in the excitation control system (VAR) or in the number of circuit and in the power flow. It is caused by the mutual effect of the oscillation between the power system and VAR. It was shown that the longitudinal power system is stabilized and power sending performance is improved, by using both faster VAR and the best designed PSS. 6 references, 27 figures, 5 tales.

40190 (CRIE–W-87024) **Influence of morphology on electrical tree initiation in polyethylene.** Hozumi, Naohiro; Okamoto, Tatsuki; Ishida, Masayoshi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jun 1988. 42p. (In Japanese). Order Number DE89760387/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In order to clarify the influence of the morphology on electrical tree initiation which appears in a breakdown of cross-linking polyethylene cable (CV cable), the specimen modeled the interface between the semiconductive layer and insulator was applied AC and impulse voltage, and the transmission electron microscope photpgraphs of minute trees immediately after the initiation were analyzed. An AC tree path is a hollow pipe of about 100nm in diameter, there is a radial concentration of lamellae to the tree starting point. The AC tree runs almost parallel to the lamellae and has cornice-like constrictions with cycle of 50-100nm. The initiation of the AC tree is suggested to be a thermal breakdown by the concentration of electric current to the local region were lamellae are concentrated. In improving the insulation to AC, controls of the lamella orientation and conductivity and smoothing of the interface are effective measures. An impulse tree path in the initial state is also a hollow pipe of about 100nm in diameter. There is no clear concentration of lamellae to the tree starting point and also no constriction of tree. To protect the initiation of the impulse tree, it is effective that the materials which absorb accelerated electron energy are arranged parallel to the lamellae. 8 references, 23 figures.

40191 (CRIE–W-87025) **Improvement of AC breakdown strength of EHV XLPE cables by diffusing an additive into the insulation.** Ishida, Masayoshi; Hozumi, Naohiro; Okamoto, Tatsuki. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jun 1988. 31p. (In Japanese). Order Number DE89760386/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

As one of reducing measures on the construction cost of EHV XLPE cable lines, a reduction of the insulation thickness is expected. An interfacial phenomenon between the insulation and the semiconduting layer is watched as a starting point of the insulation breakdown. An improvement of the insulation breakdown value was studied by diffusing an additive into the semiconducting layer. Polyglycerol fatty acid ester was used for effective additive, the disc specimens with the semiconducting layer mixes the additive from 0 to 5 % in weight, were prepared for the breakdown tests. A concentration measuring method for trace additive was developed using a FT-IR microfocus system, then the additive distributions diffused in the insulation layer were analyzed. The distributions profiles were built up in close proportion to the concentration of the mixed additive. A maximum breakdown strength at low breakdown probability was shown in the additive concentration range of 3-5%. The weibull breakdown strength is improved with increase of the mixing concentration, the additive has an effect on reducing a fault which causes the breakdown. The improvement of A C breakdown strength and the reduction of the insulation thickness are expected using the semiconducting layer mixed the additive. The optimal mixing concentration is about 3%. 10 references, 20 figures, 7 tables.

40192 (ECRC/M–2363) **Examination of the breakdown site in new and aged polyethylene insulated cables.** Naybour, R.D. Electricity Council Research Centre, Capenhurst (UK). Apr 1989. 9p. Available from Available from: Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

This report describes the work carried out to determine the above effects on a sample of MIND, solid, paper cable. A pulse discrimination system (PDS) was used to minimise the effect of external interference and achieve sensitivity down to 1 pC without elaborate screening or filters. Inception voltage is unaffected by frequencies between 500 Hz and 1.0 Hz but increases when the test frequency is lowered below 0.1 Hz. Lowering of the test frequency below 500

Hz tends to reduce the number of smallest and largest discharge magnitudes with a less pronounced effect on those of intermediate magnitudes. It is concluded that 0.1 Hz is suitable for discharge location in cables because the results can be correlated with those obtained at 50 Hz. (author).

40193 (ECRC/R–2386) **Effects of voltage and frequency on the partial discharge characteristics of hv paper cables.** Domun, M.K. Electricity Council Research Centre, Capenhurst (UK). Jun 1989. 5p. Available from Available from: Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

A method of monitoring and detecting discharges during tests to breakdown on 11kV cables is described. In twenty tests to breakdown no discharges greater than 1 pC were detected until the breakdown event. The energy at breakdown was limited and the discharge location system was required to locate the failure site. No evidence of a deterioration was obtained on cross-linked polyethylene insulation. (author).

40194 (EPRI-EL–4651-Vol.2) **Electromagnetic transients program (EMTP): Volume 2, Workbook II: Final report.** Alvarado, F.L. Electric Power Research Inst., Palo Alto, CA (USA); Wisconsin Univ., Madison, WI (USA). Dept. of Electrical and Computer Engineering. c Jun 1989. 259p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This workbook is the second in a series of books to introduce the EMTP to users. It assumes that the user is familiar with elementary uses of the EMTP and presents more advanced modeling techniques. The workbook uses a case-study approach, where gradually more sophisticated models of the same system are introduced. The book starts with a description of cable modeling and electromagnetic induction. As in Workbook I, the idea is not only to show how to create models using the EMTP, but also how to obtain reasonable values for necessary parameters, and what and how to simulate it. Detailed templates to facilitate the creation of data for the EMTP are also provided. The book then introduces frequency dependent line models. Other topics covered include: statistical studies using EMTP, circuit breaker models and frequency dependent source representation. A final chapter discusses insulation coordination. This last chapter is largely stand-alone, and can be used as an introduction to the material rather than a recapitulation of the book, if so desired. 112 figs.

40195 (EPRI-EL–4651-Vol.4) **Electromagnetic transients program (EMTP): Volume 4, Workbook IV (TACS) [Transients Analysis of Control Systems]: Final report.** Lasseter, R.H. Electric Power Research Inst., Palo Alto, CA (USA); Wisconsin Univ., Madison, WI (USA). Dept. of Electrical and Computer Engineering. c Jun 1989. 222p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This workbook represents an introduction to the use of TACS (Transients Analysis of Control Systems) in the EMTP. The material progresses from an overview of basic TACS concepts and components to a detailed HVDC model. The following application of TACS are covered: a variable load problem, static Var systems, thyristor models, TCR, basic HVDC models and a detailed HVDC model. Complete data files are given for most examples.

40196 (EPRI-EL–6426) **Distribution transformer basic insulation level reduction: Feasibility study: Final report.** Baranowski, J.F.; Goedde, G.L. Electric Power Research Inst., Palo Alto, CA (USA); McGraw-Edison Co., Franksville, WI (USA). c Jul 1989. 55p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Conventional oil-immersed distribution transformers have 60 Hz voltage withstand and basic impulse insulation levels (BIL) that have been developed over the years, based on product performance, and specified in ANSI Standard C57. For years, some oil-immersed power class transformers have been specified at 1 to 2-1/2 steps reduction in BIL below the standard level. Improved surge protection devices have primarily been responsible for this reduction in BIL on power transformers. This project investigated reducing the BIL of oil-immersed conventional distribution transformers. A projected distribution transformer market makeup determined the popular kVA sizes voltages for the 5 kV to 35 kV insulation classes of pole-type and pad-mount distribution transformers. Reduced BIL design cases were used to determine the impact on the transformer's design and performance. The final results provided both industry cost savings and total owning cost (TOC) savings. Some caution must be followed on protecting these reduced BIL distribution transformers. 17 refs., 18 tabs.

40197 (EPRI-EL–6461) **Performance indexes for predicting voltage collapse: Final report.** Fischl, R. Electric Power Research Inst., Palo Alto, CA (USA); Drexel Univ., Philadelphia, PA (USA). Dept. of Electrical and Computer Engineering. c Jul 1989. 160p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report gives a methodology for evaluating the accuracy of voltage collapse criteria (such as, Voltage Collapse Proximity Indicator, Load Flow Feasibility Index, Steady State Stability Index, etc.) for predicting impending voltage collapse in power systems. The evaluation is done in the framework of the decision the operator makes and thus evaluates the risk of making the wrong decision. It is shown that for each voltage collapse criterion, one can quantify the error in the decision and determine the tradeoffs made between the probability of missing and false alarm of voltage collapse. To achieve this a set theoretic framework is established for the analysis of voltage collapse. This framework, called Voltage Security region, integrates both the steady-state and dynamic voltage collapse phenomena in a unified structure. The voltage security region framework is used to review various proposed voltage collapse criteria in a unified manner and evaluate their effectiveness (i.e., probability of miss and false alarm) in predicting voltage collapse. It is shown that at least two voltage collapse criteria are needed to predict impending voltage collapse: one for the steady-state phenomena and the other for the dynamic phenomena of voltage collapse. Finally, numerous examples are given to illustrate the concepts and the methodology. Most of the results are presented graphically to give a pictorial insight into the construction of the Voltage Security regions and the evaluation of the voltage collapse criteria. 43 refs., 64 figs., 10 tabs.

40198 (EPRI-EL–6462-M) **Mutual design: Overhead transmission lines and railroad facilities: Susceptibility program: Final report.** Frazier, M.J.; Little, D.R. Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., Hoffman Estates, IL (USA); Burg and Associates, Greensburg, PA (USA). c Jul 1989. 155p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The sharing of common corridors by electric power transmission lines and railroad facilities can result in the coupling of unwanted electromagnetic energy from the power lines into nearby railroad systems. The coupling can result in voltage being induced onto the railroad system conductors that may compromise the inherent safety and reliability of the railroad signalling system. This broad-scoped research program, which is co-sponsored by EPRI and the AAR, is addressing the problem from two directions. This two volume report describes a Phase 1 effort to develop the methods and techniques for quantifying the signal system response to interference. 54 figs., 7 tabs.

40199 (FRCEA-TH–200) **Computer aided method of low voltage power distribution networks protection system against lightning and electromagnetic pulse generated by high altitude nuclear burst.** Laroubine, J. Paris-11 Univ., 91 - Orsay (France). 1989. 85p. (In French). Order Number DE89903158/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The lightning creates an electromagnetic field which produces a slow duration and high energy pulse of current on low voltage power distribution networks. On the other hand an high altitude nuclear burst generates an electromagnetic pulse which causes fast and intense interferences. We describe here the specifications of a passive filter that can reject these interferences. We used a computer aided method of simulation to create a prototype. Experimental results confirm the validity of the model used for simulation.

21 NUCLEAR POWER PLANTS

Refer also to citation(s) 40086

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

Refer also to citation(s) 40037, 40212, 40213, 40214, 40240, 40251, 40252, 40257, 40265, 40270, 40271, 40280, 40282, 40283, 40284, 40285, 40286, 40287, 40288, 40289, 40290, 40292, 40293, 40294, 40295, 40296, 40297, 40298, 40299, 40300, 40301, 40304, 40305, 40307, 40314, 40689

40200 (ENEA-RT-PAS–89-2) **Radiological characterization of nuclear plants under decommissioning. Problems and experiences.** Mincarini, M. ENEA, Rome (Italy). 1989. 54p. (In Italian). Order Number DE89633529/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

In the present work a description of major problems encountered in qualitative and quantitative radiological characterization of nuclear plants for decommissioning and decontamination purpose is presented. Referring to several nuclear plant classes activation and contamination processes, direct and indirect radiological analysis and some italian significant experience are descripted.

40201 (EPRI-NP–6331) **Performance assessment of advanced engineering workstations for fuel management applications: Final report.** Turinsky, P.J. Electric Power Research Inst., Palo Alto, CA (USA); North Carolina State Univ., Raleigh, NC (USA). c Jul 1989. 156p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The purpose of this project was to assess the performance of an advanced engineering workstation [AEW] with regard to applications to incore fuel management for LWRs. The attributes of most interest to us that define an AEW are parallel computational hardware and graphics capabilities. The AEWs employed were super microcomputers manufactured by MASSCOMP, Inc. These computers utilize a 32-bit architecture, graphics co-processor, multi-CPUs [up to six] attached to common memory and multi-vector accelerators. 7 refs., 33 figs., 4 tabs.

40202 (IWGFPT–31) **Burnup determination of water reactor fuel.** International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. 1989. 88p. (CONF-8806392–Summs.: IAEA technical committee meeting on burnup determination of water reactor fuel, Karlsruhe (Germany, F.R.), 13-16 Jun 1988). Order Number DE89014735/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI.

This document presents reports at a meeting scheduled by the International Atomic Energy Agency in consultation with the Members of the International Working Group on Water Reactor Fuel Performance and Technology. Twenty-seven participants from eleven countries plus two international organizations attended the Meeting. Twelve papers were given during three technical sessions, followed by a panel discussion which allowed to formulate the conclusions of the meeting and recommendations to the Agency. In addition, participants were invited to give an outline of their national programmes, related to Burnup Determination of Water Reactor Fuel. At the occasion of this meeting, it was stressed that analysis of highly burnt fuels, mixed oxides and burnable absorber bearing fuels required extension of the experimental data base, to comply with the increasing demand for an improved fuel management, including better qualification of reactor physics codes. Individual papers have been cataloged separately.

40203 (SAND–88-2237C) **Testing to determine the leakage behavior of inflatable seals subject to severe accident loadings.** Parks, M.B. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890855–2: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89008713/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Under the sponsorship of the United Sates Nuclear Regulatory Commission, Sandia National Laboratories is currently developing test validated methods to predict the pressure capacity, at elevated temperatures, of light water reactor (LWR) nuclear containment vessels subject to loads well beyond their design basis – the so-called severe accident. Scale model tests of containments with the major penetrations represented have been carried to functional failure by internal pressurization. Also, combined pressure and elevated temperature tests of typical compression seals and gaskets, a full size personnel airlock, and of typical electrical penetration assemblies (EPAs), have been conducted in order to better understand the leakage behavior of containment penetrations (von Riesemann, et al. 1988). Because inflatable seals are also a part of the pressure boundary of some containments, it is important to understand their leakage behavior as well. This paper discusses the results of tests that were performed to better define the leakage behavior of inflatable seals when subjected to loads well beyond their design basis. 1 ref., 6 figs., 3 tabs.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

Refer also to citation(s) 39930, 39943, 40188, 40200, 40201, 40202, 40203, 40236, 40251, 40252, 40253, 40257, 40260, 40265, 40267, 40268, 40269, 40271, 40276, 40280, 40281, 40282, 40283, 40285, 40286, 40287, 40288, 40289, 40290, 40291, 40292, 40293, 40294, 40295, 40296, 40297, 40298, 40299, 40300, 40301, 40304, 40305, 40306, 40308, 40309, 40314, 40316, 40689

40204 (EPRI-NP–6032) **An independent spent-fuel storage installation at Surry Station: Design and operation.** McKay, H.S.; Wakeman, B.H.; Pickworth, J.M.; Routh, S.D.; Hopkins, W.C. Electric Power Research Inst., Palo Alto, CA (USA); Virginia Power Co., Richmond, VA (USA); Bechtel Power Corp., Gaithersburg, MD (USA). c Jul 1989. 104p. Sponsored by DOE/NE;EPRI. DOE Contract AC06-76RL01830. (PNL–6843). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Design and licensing of the Surry Power Station Independent Spent Fuel Storage Installation (ISFSI) was initiated in 1982 by Virginia Power as part of a comprehensive strategy to increase spent fuel storage capacity at the Station. Designed to use large, metal dry storage casks, the Surry ISFSI will accommodate 84 such casks with a total storage capacity of 811 MTU of spent PWR fuel assemblies. The ISFSI is located at the Surry Station in a wooded area approximately 1000 meters (3300 feet) east of the reactor facilities. Construction of the first of three reinforced concrete storage pads and its associated support systems was completed in March 1986. The operating license and Technical Specifications were issued by the US NRC on July 2, 1986. Initial loading operations of a General Nuclear Systems, Inc., CASTOR V/21 storage cask began in September 1986. The first two CASTOR V/21 casks were placed in storage at the ISFSI in December 1986. 16 refs., 33 figs., 16 tabs.

40205 (EPRI-NP–6192-M) **Examination of roller expansion transitions in Point Beach Unit 1 steam generator tubing: Final report.** Frye, C.R. Electric Power Research Inst., Palo Alto, CA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Lynchburg Research Center. c Jul 1989. 25p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The steam generators at Point Beach Unit 1 were replaced in 1983 because IGA in the part of the tubes within the tubesheet crevice required a power reduction that was unacceptable for long-term operation. Subsequent to the replacement, a section of the tubesheet containing 13 intact tubes and 16 split tubes around the periphery of the section was removed for examination by various contractors. The split tubes which are the subject of this report, were cleaned and examined by fluorescent penetrant inspection and metallography to determine the incidence of ID and OD cracking in the region of the roll transition. The results suggest that roll expansions of the type used in the Point Beach steam generators produce residual stresses high enough to cause OD stress corrosion cracking in aggressive environments. It appears that the residual stresses are not high enough to cause pure water stress corrosion cracking even in susceptible material. 8 refs.

40206 (KFKI–1989-10/G) **Reflooding investigations Pt. 1.** Baranyai, G.; Csom, V.; Maetz, E.; Maroti, L.; Takacs, A.; Trosztel, I.; Windberg, P. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 59p. (In Hungarian). Order Number DE89633559/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

During loss-of-coolant accident (LOCA) in a nuclear reactor, the calculation of reflooding and rewetting processes invokes a number of problems to be solved on interdisciplinary areas. Calculation of the reflooding phase of a LOCA for WWER-1000 type reactors requires experimental investigation of the process. A detailed description of the experimental facility for obtaining LOCA simulation results is given, based on the investigation of necessary and possible ranges of parameters. Some preliminary measurement results are also presented. (R.P.) 2 refs.; 32 figs.; 3 tabs.

40207 (KFKI–1989-11/G) **Description of physical models applied in the COCONT code.** Maroti, L.; Trosztel, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 22p. (In Hungarian). Order Number DE89633560/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

For the solution of thermohydraulic problems of the core of WWER type pressurized water nuclear reactors, several physical models or empirical relationships, correlations were considered. During this research various models were included in the COBRA and COCONT codes used for subchannel analysis. A detailed description of these models incorporated in the COCONT code is given, yielding best estimate calculations for WWER type reactor core processes. (R.P.) 9 refs.; 5 figs.

40208 (KFKI–1989-12/G) **Investigation of the COBRA and COCONT codes by comparison of calculated results.** Maroti, L.; Trosztel, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 22p. (In Hungarian). Order Number DE89633561/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Two codes used widely for subchannel thermohydraulic analysis of WWER type nuclear reactor are the COBRA and COCONT codes, the latter being a simplified version of the former one. The main features of the simplified COCONT program are the supposition of an entirely open subchannel system in the radial direction, and the direct application to WWER reactors. The results of calculations conducted to compare COBRA and COCONT codes are summarized. It was shown by the comparison that the results by the COCONT program are conservative, and the simplifications applied in this code increase the reactor safety. (R.P.) 7 refs.; 2 figs.; 2 tabs.

40209 (KFKI–1989-13/G) **Operational procedure based on hot spot analysis in the WWER-440 type reactors of the Paks Nuclear Power Plant Pt. 3.** Maroti, L.; Trosztel, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 26p. (In Hungarian). Order Number DE89633562/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The most significant thermohydraulic characteristics, their extreme values and effects are discussed, and some methods used for the determination of extreme marginal values of parameters that are basic input data for reactor safety calculations are described. The hydraulic characteristics discussed here influence the coolant flow in the reactor active core. The methods presented are applied for WWER type reactors, and the results of calculations are possible to carry out conservative investigations of reactors. (R.P.) 7 refs.; 2 figs.; 1 tab.

40210 (NIIAR–1(712)) **Organization of data bank for fast reactor fuel elements and assemblies.** Maershin, A.A.; Rudkevich, A.V.; Volkov, A.E. and others. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1987. 12p. (In Russian). Order Number DE89633563/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Structure and functions of data bank realized in the framework of factographic information retrieval system on reactor materials testing are considered. The data bank is designated for storage, retrieval and processing of the information on fast reactor fuel elements and assemblies (FA). The sections of data base applied field corresponding to the stages of fabrication, irradiation and investigation of FA with oxide fuels are described. Fuel element and FA parameters are presented in data base of relational type; this provides for the symmetry of data access and simplicity of the base modification. The data bank software is described and the problems of interaction with it are considered. Library of standard parametrized requests is used for a dialogue. 6 refs.; 2 figs.

40211 (SAND–88-2190C) **Analytical study of the failure modes and capacity of the Sequoyah containment.** Miller, J.D.; Clauss, D.B. Sandia National Labs., Albuquerque, NM (USA). 1988. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890855–3: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89009072/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories, in its role as manager of the Containment Integrity Programs for the United States Nuclear Regulatory Commission (NRC), has developed analytical techniques for predicting the performance of light water reactor steel containment buildings subject to loads beyond the design basis. The analytical techniques are based on experience with large scale steel containment model tests. Results of the model tests provided important insights into the structural response of steel containments and experimental validation of the analytical methods. The methodology for analyzing steel containments has advanced to the point that the NRC asked Sandia to demonstrate these analytical techniques on an actual steel containment building under hypothetical conditions of severe accident loading. The objective of the analysis was to determine the actual pressure capacity and the mode, location, and size of failure, based on a functional definition of failure. The Sequoyah Unit 1 containment building was selected for the analysis for several reasons. It has a steel ice-condensor containment which was similar in many respects to the 1:8-scale model that was tested by Sandia (Koenig, 1986). Sequoyah is one of the reference plants in the NUREG-1150 study (USNRC, 1987) and has been analyzed repeatedly; thus it is a useful benchmark for advances in analytic capabilities. Finally, it was shut down at the time the study was initiated, which allowed for first-hand inspection of the containment by the analysts. This document provides details of the analysis. 7 refs., 7 figs., 1 tab.

40212 (STUK-B-YTO–51) **Operation of Finnish nuclear power plants. Quarterly report, 4. quarter, 1987 and the annual summary.** Heimburger, H. and others. Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland). Dept. of Nuclear Safety. Aug 1988. 25p. Order Number DE89633564/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This general review of the operation of the Finnish nuclear power plants concentrates on such events and discoveries related to nuclear and radiation safety as the regulatory body, the Finnish Centre for Radiation and Nuclear Safety, regards as noteworthy. The report also includes a summary of the radiation safety of the personnel and the environment, as well as tabulated data on the production and load factors of the plants. In the report period, no event essentially degraded plant safety nor posed a radiation hazard to the personnel or the environment.

40213 (STUK-B-YTO–52) **Operation of Finnish nuclear power plants. Quarterly report, 1. quarter 1988.** Haenninen, R. and others. Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland). Dept. of Nuclear Safety. Sep 1988. 23p. Order Number DE89633565/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This general review of the operation of the Finnish nuclear power plants concentrates on such events and discoveries related to nuclear and radiation safety as the regulatory body, the Finnish Centre for Radiation and Nuclear Safety, regards as noteworthy. The report also includes a summary of the radiation safety of the personnel and the environment, as well as tabulated data on the production and load factors of the plants. In the report period, no event essentially degraded plant safety nor posed a radiation hzard to the personnel or the environment.

21 NUCLEAR POWER PLANTS

Refer also to citation(s) 40086

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

Refer also to citation(s) 40037, 40212, 40213, 40214, 40240, 40251, 40252, 40257, 40265, 40270, 40271, 40280, 40282, 40283, 40284, 40285, 40286, 40287, 40288, 40289, 40290, 40292, 40293, 40294, 40295, 40296, 40297, 40298, 40299, 40300, 40301, 40304, 40305, 40307, 40314, 40689

40200 (ENEA-RT-PAS–89-2) **Radiological characterization of nuclear plants under decommissioning. Problems and experiences.** Mincarini, M. ENEA, Rome (Italy). 1989. 54p. (In Italian). Order Number DE89633529/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

In the present work a description of major problems encountered in qualitative and quantitative radiological characterization of nuclear plants for decommissioning and decontamination purpose is presented. Referring to several nuclear plant classes activation and contamination processes, direct and indirect radiological analysis and some italian significant experience are descripted.

40201 (EPRI-NP–6331) **Performance assessment of advanced engineering workstations for fuel management applications: Final report.** Turinsky, P.J. Electric Power Research Inst., Palo Alto, CA (USA); North Carolina State Univ., Raleigh, NC (USA). c Jul 1989. 156p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The purpose of this project was to assess the performance of an advanced engineering workstation [AEW] with regard to applications to incore fuel management for LWRs. The attributes of most interest to us that define an AEW are parallel computational hardware and graphics capabilities. The AEWs employed were super microcomputers manufactured by MASSCOMP, Inc. These computers utilize a 32-bit architecture, graphics co-processor, multi-CPUs [up to six] attached to common memory and multi-vector accelerators. 7 refs., 33 figs., 4 tabs.

40202 (IWGFPT–31) **Burnup determination of water reactor fuel.** International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. 1989. 88p. (CONF-8806392–Summs.: IAEA technical committee meeting on burnup determination of water reactor fuel, Karlsruhe (Germany, F.R.), 13-16 Jun 1988). Order Number DE89014735/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI.

This document presents reports at a meeting scheduled by the International Atomic Energy Agency in consultation with the Members of the International Working Group on Water Reactor Fuel Performance and Technology. Twenty-seven participants from eleven countries plus two international organizations attended the Meeting. Twelve papers were given during three technical sessions, followed by a panel discussion which allowed to formulate the conclusions of the meeting and recommendations to the Agency. In addition, participants were invited to give an outline of their national programmes, related to Burnup Determination of Water Reactor Fuel. At the occasion of this meeting, it was stressed that analysis of highly burnt fuels, mixed oxides and burnable absorber bearing fuels required extension of the experimental data base, to comply with the increasing demand for an improved fuel management, including better qualification of reactor physics codes. Individual papers have been cataloged separately.

40203 (SAND–88-2237C) **Testing to determine the leakage behavior of inflatable seals subject to severe accident loadings.** Parks, M.B. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890855–2: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89008713/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Under the sponsorship of the United Sates Nuclear Regulatory Commission, Sandia National Laboratories is currently developing test validated methods to predict the pressure capacity, at elevated temperatures, of light water reactor (LWR) nuclear containment vessels subject to loads well beyond their design basis – the so-called severe accident. Scale model tests of containments with the major penetrations represented have been carried to functional failure by internal pressurization. Also, combined pressure and elevated temperature tests of typical compression seals and gaskets, a full size personnel airlock, and of typical electrical penetration assemblies (EPAs), have been conducted in order to better understand the leakage behavior of containment penetrations (von Riesemann, et al. 1988). Because inflatable seals are also a part of the pressure boundary of some containments, it is important to understand their leakage behavior as well. This paper discusses the results of tests that were performed to better define the leakage behavior of inflatable seals when subjected to loads well beyond their design basis. 1 ref., 6 figs., 3 tabs.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

Refer also to citation(s) 39930, 39943, 40188, 40200, 40201, 40202, 40203, 40236, 40251, 40252, 40253, 40257, 40260, 40265, 40267, 40268, 40269, 40271, 40276, 40280, 40281, 40282, 40283, 40285, 40286, 40287, 40288, 40289, 40290, 40291, 40292, 40293, 40294, 40295, 40296, 40297, 40298, 40299, 40300, 40301, 40304, 40305, 40306, 40308, 40309, 40314, 40316, 40689

40204 (EPRI-NP–6032) **An independent spent-fuel storage installation at Surry Station: Design and operation.** McKay, H.S.; Wakeman, B.H.; Pickworth, J.M.; Routh, S.D.; Hopkins, W.C. Electric Power Research Inst., Palo Alto, CA (USA); Virginia Power Co., Richmond, VA (USA); Bechtel Power Corp., Gaithersburg, MD (USA). c Jul 1989. 104p. Sponsored by DOE/NE;EPRI. DOE Contract AC06-76RL01830. (PNL–6843). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Design and licensing of the Surry Power Station Independent Spent Fuel Storage Installation (ISFSI) was initiated in 1982 by Virginia Power as part of a comprehensive strategy to increase spent fuel storage capacity at the Station. Designed to use large, metal dry storage casks, the Surry ISFSI will accommodate 84 such casks with a total storage capacity of 811 MTU of spent PWR fuel assemblies. The ISFSI is located at the Surry Station in a wooded area approximately 1000 meters (3300 feet) east of the reactor facilities. Construction of the first of three reinforced concrete storage pads and its associated support systems was completed in March 1986. The operating license and Technical Specifications were issued by the US NRC on July 2, 1986. Initial loading operations of a General Nuclear Systems, Inc., CASTOR V/21 storage cask began in September 1986. The first two CASTOR V/21 casks were placed in storage at the ISFSI in December 1986. 16 refs., 33 figs., 16 tabs.

40205 (EPRI-NP–6192-M) **Examination of roller expansion transitions in Point Beach Unit 1 steam generator tubing: Final report.** Frye, C.R. Electric Power Research Inst., Palo Alto, CA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Lynchburg Research Center. c Jul 1989. 25p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The steam generators at Point Beach Unit 1 were replaced in 1983 because IGA in the part of the tubes within the tubesheet crevice required a power reduction that was unacceptable for long-term operation. Subsequent to the replacement, a section of the tubesheet containing 13 intact tubes and 16 split tubes around the periphery of the section was removed for examination by various contractors. The split tubes which are the subject of this report, were cleaned and examined by fluorescent penetrant inspection and metallography to determine the incidence of ID and OD cracking in the region of the roll transition. The results suggest that roll expansions of the type used in the Point Beach steam generators produce residual stresses high enough to cause OD stress corrosion cracking in aggressive environments. It appears that the residual stresses are not high enough to cause pure water stress corrosion cracking even in susceptible material. 8 refs.

40206 (KFKI–1989-10/G) **Reflooding investigations Pt. 1.** Baranyai, G.; Csom, V.; Maetz, E.; Maroti, L.; Takacs, A.; Trosztel, I.; Windberg, P. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 59p. (In Hungarian). Order Number DE89633559/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

During loss-of-coolant accident (LOCA) in a nuclear reactor, the calculation of reflooding and rewetting processes invokes a number of problems to be solved on interdisciplinary areas. Calculation of the reflooding phase of a LOCA for WWER-1000 type reactors requires experimental investigation of the process. A detailed description of the experimental facility for obtaining LOCA simulation results is given, based on the investigation of necessary and possible ranges of parameters. Some preliminary measurement results are also presented. (R.P.) 2 refs.; 32 figs.; 3 tabs.

40207 (KFKI–1989-11/G) **Description of physical models applied in the COCONT code.** Maroti, L.; Trosztel, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 22p. (In Hungarian). Order Number DE89633560/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

For the solution of thermohydraulic problems of the core of WWER type pressurized water nuclear reactors, several physical models or empirical relationships, correlations were considered. During this research various models were included in the COBRA and COCONT codes used for subchannel analysis. A detailed description of these models incorporated in the COCONT code is given, yielding best estimate calculations for WWER type reactor core processes. (R.P.) 9 refs.; 5 figs.

40208 (KFKI–1989-12/G) **Investigation of the COBRA and COCONT codes by comparison of calculated results.** Maroti, L.; Trosztel, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 22p. (In Hungarian). Order Number DE89633561/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Two codes used widely for subchannel thermohydraulic analysis of WWER type nuclear reactor are the COBRA and COCONT codes, the latter being a simplified version of the former one. The main features of the simplified COCONT program are the supposition of an entirely open subchannel system in the radial direction, and the direct application to WWER reactors. The results of calculations conducted to compare COBRA and COCONT codes are summarized. It was shown by the comparison that the results by the COCONT program are conservative, and the simplifications applied in this code increase the reactor safety. (R.P.) 7 refs.; 2 figs.; 2 tabs.

40209 (KFKI–1989-13/G) **Operational procedure based on hot spot analysis in the WWER-440 type reactors of the Paks Nuclear Power Plant Pt. 3.** Maroti, L.; Trosztel, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 26p. (In Hungarian). Order Number DE89633562/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The most significant thermohydraulic characteristics, their extreme values and effects are discussed, and some methods used for the determination of extreme marginal values of parameters that are basic input data for reactor safety calculations are described. The hydraulic characteristics discussed here influence the coolant flow in the reactor active core. The methods presented are applied for WWER type reactors, and the results of calculations are possible to carry out conservative investigations of reactors. (R.P.) 7 refs.; 2 figs.; 1 tab.

40210 (NIIAR–1(712)) **Organization of data bank for fast reactor fuel elements and assemblies.** Maershin, A.A.; Rudkevich, A.V.; Volkov, A.E. and others. Nauchno-issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1987. 12p. (In Russian). Order Number DE89633563/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Structure and functions of data bank realized in the framework of factographic information retrieval system on reactor materials testing are considered. The data bank is designated for storage, retrieval and processing of the information on fast reactor fuel elements and assemblies (FA). The sections of data base applied field corresponding to the stages of fabrication, irradiation and investigation of FA with oxide fuels are described. Fuel element and FA parameters are presented in data base of relational type; this provides for the symmetry of data access and simplicity of the base modification. The data bank software is described and the problems of interaction with it are considered. Library of standard parametrized requests is used for a dialogue. 6 refs.; 2 figs.

40211 (SAND–88-2190C) **Analytical study of the failure modes and capacity of the Sequoyah containment.** Miller, J.D.; Clauss, D.B. Sandia National Labs., Albuquerque, NM (USA). 1988. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890855–3: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89009072/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories, in its role as manager of the Containment Integrity Programs for the United States Nuclear Regulatory Commission (NRC), has developed analytical techniques for predicting the performance of light water reactor steel containment buildings subject to loads beyond the design basis. The analytical techniques are based on experience with large scale steel containment model tests. Results of the model tests provided important insights into the structural response of steel containments and experimental validation of the analytical methods. The methodology for analyzing steel containments has advanced to the point that the NRC asked Sandia to demonstrate these analytical techniques on an actual steel containment building under hypothetical conditions of severe accident loading. The objective of the analysis was to determine the actual pressure capacity and the mode, location, and size of failure, based on a functional definition of failure. The Sequoyah Unit 1 containment building was selected for the analysis for several reasons. It has a steel ice-condensor containment which was similar in many respects to the 1:8-scale model that was tested by Sandia (Koenig, 1986). Sequoyah is one of the reference plants in the NUREG-1150 study (USNRC, 1987) and has been analyzed repeatedly; thus it is a useful benchmark for advances in analytic capabilities. Finally, it was shut down at the time the study was initiated, which allowed for first-hand inspection of the containment by the analysts. This document provides details of the analysis. 7 refs., 7 figs., 1 tab.

40212 (STUK-B-YTO–51) **Operation of Finnish nuclear power plants. Quarterly report, 4. quarter, 1987 and the annual summary.** Heimburger, H. and others. Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland). Dept. of Nuclear Safety. Aug 1988. 25p. Order Number DE89633564/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This general review of the operation of the Finnish nuclear power plants concentrates on such events and discoveries related to nuclear and radiation safety as the regulatory body, the Finnish Centre for Radiation and Nuclear Safety, regards as noteworthy. The report also includes a summary of the radiation safety of the personnel and the environment, as well as tabulated data on the production and load factors of the plants. In the report period, no event essentially degraded plant safety nor posed a radiation hazard to the personnel or the environment.

40213 (STUK-B-YTO–52) **Operation of Finnish nuclear power plants. Quarterly report, 1. quarter 1988.** Haenninen, R. and others. Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland). Dept. of Nuclear Safety. Sep 1988. 23p. Order Number DE89633565/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

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40214 (STUK-B-YTO–58) **Operation of Finnish nuclear power plants. Quarterly report, 4. quarter, 1988 and the annual summary.** Ottosson, C. and others. Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland). Dept. of Nuclear Safety. May 1989. 30p. Order Number DE89633566/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This general review of the operation of the Finnish nuclear power plants concentrates on such events and discoveries related to nuclear and radiation safety as the regulatory body, the Finnish Centre for Radiation and Nuclear Safety, regards as noteworthy. The report also includes a summary of the radiation safety of the personnel and the environment, as well as tabulated data on the production and load factors of the plants. In the report period, no event essentially degraded plant safety nor posed a radiation hazard to the personnel or the environment.

2103 Power Reactors, Non-breeding, Graphite Moderated

Refer also to citation(s) 40254, 40277, 40313, 40888, 40889, 40890, 40891, 40892, 40895, 40899

40215 (IA–1411) **Dynamic simulation of a pebble bed high temperature gas cooled reactor.** Rodnizki, J. Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center. Sep 1988. 255p. (In Hebrew). Order Number DE89633590/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A safety analysis of the PNP 500 High Temperature Gas Cooled Reactor (HTGR) was performed. The fuel is embedded in a matrix of graphite spheres containing UO_2 particles - Pebble Bed Reactor, and the output power of the plant is 500 MW (t). The safety analysis is aimed at describing the system behavior following perturbations in its state variables. Anticipated transients were studied using full-scale simulation of the PNP 500, and the resulting temperatures, pressures and mass flows were compared with their permitted values. The analysis was performed in a modular form in which each module stands for a physical component. The computer code was written using DSNP - Dynamic Simulator for Nuclear Power Plants - and the modules developed for HTGR were introduced into the DSNP libraries. The results obtained by simulation of the modules were compared with those derived from analytical calculations. The Gear integration method was included in the DSNP and a new integration method was developed for stiff equations (using the second order Runge - Kutta method with exponential fitting). These integration methods were compared with older ones, and Gear's was found to give the best performance. The following transients were studied: (a) a loss of coolent accident, (b) a step perturbation in reactivity, (c) a step reduction in turbine power, (d) coastdown of the main cooling system. The PNP was found to have a slow reaction time due to its high graphite heat capacity. The consequences of the studied accidents were shown to be limited due to the inherent safety features of the HTGR. The results were compared and found to be in good agreement with those obtained from the COROX and SHOVAV-JUL codes. (author). 72 refs.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 40239

40216 (INIS-mf–11460, pp. 174-193) **In-service inspection of steam generator pipes.** Moguillanes, C. (Empresa Nuclear Argentina de Centrales Electricas S.A., Buenos Aires (Argentina)); Cosimano, J.J.; Garay, E.; Negri, O. Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Tasks achieved during in-service inspection by Eddy currents in steam generator pipes of Atucha Reactor are described. Argentinian technicians made an "on-the-job training" under the supervision of KWU's personnel. This inspection was realized between November and December 1987.

40217 (INIS-mf–11460, pp. 310-324) **Separating rings detection in fuel channels of Embalse NPP.** Obrutsky, L.S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Otero, P.A.; Schmidt, O.A. Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The design specifications of Embalse Nuclear Power Plants (CANDU Type Reactor 600Mw) define the positions to be taken by 4 separating rings of the fuel channels. Experience has demonstrated the displacement possibility of the above mentioned rings. It means a risk of contact between pressure tube and calandria tube. In order to determine the position of separating rings, an inspection system based on Eddy Currents technique was developed by CNEA personnel. Detection is performed through two special probes operating according the "emitter-receiver" principle. Obtained signals and its relative position are recorded in a video tape and registered in paper. The probe is telecommanded by an automatic equipment. In this paper the construction and calibration of the detection equipment is described, as well as the propulsion. Final results are also outlined in the inspection carried out in November 1986 when an effective displacement of separating rings was verified from its design position in most of the inspected tubes.

2105 Power Reactors, Breeding

Refer also to citation(s) 40202, 40243, 40244, 40245, 40246, 40247, 40248, 40250, 40252, 40303, 40315

40218 (CONF-8903129–1) **The Integral Fast Reactor (IFR) concept.** Till, C.E.; Chang, Y.I. Argonne National Lab., IL (USA). 1989. 5p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 7. Pacific basin conference; San Diego, CA (USA); 4-8 Mar 1989. Order Number DE89013179/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In addition to maintaining the viability of its present commercial nuclear technology, a principal challenge in the US in the 1990s and beyond will be to regain and maintain a position among the world leadership in advanced reactor research and development. In this paper we'll discuss factors which we believe should today provide the rationale and focus for advanced reactor R and D, and we will then review the status of the major US effort, the Integral Fast Reactor (IFR) program.

40219 (EUR–11925) **Comparative analysis of a hypothetical loss-of-flow accident in an irradiated LMFBR core using different computer models for a common benchmark problem.** Wider, H.U.; Devos, J.; Nguyen, H.; Goethem, G. Van.; Leslie, R.; Rudge, T.; Struwe, D.; Royl, P.; Miles, K.J.; Tentner, A.M. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 143p. Available from NTIS (US Sales Only), PC A07/MF A01.

This report summarizes the results of an international exercise to compare whole-core accident calculations of the initiation phase of an unprotected LOF accident in a large irradiated LMFBR. The results for the accident phase before pin failure are in rather good agreement except for the fuel pin mechanics predictions. There are also some differences in the sodium boiling calculations but the voiding rates which are of key importance are very similar. The post - failure fuel motion and sodium voiding predictions show significant differences. However, the majority of these calculations agree that temporary fuel accumulations occur which increase the power beyond that caused by sodium voiding alone.

40220 (FEI–1893) **On errors in calculations of parameters of critically, breeding and energy release in the BN-800 type reactor model.** Van'kov, A.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 12p. (In Russian). Order Number DE89633486/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Neutron balance optimization and equilization of energy release field are considered to be the important problems of modern BN-type reactor design. Nuclear constants remain to be the principle source of errors for corresponding reactor calculations. They contribute both directly to dispersion of calculated values and as a result of error compensation in neutron multiplication factor by varying fuel charge (fuel assembly number). Sensitivity factors of criticality, breeding and energy release field parameters to all constants, contributing much to the uncertainty are calculated. Error estimations for the version of the BN-800 reactor three-dimensional diffusion model are obtained. 9 refs.; 2 figs.

40221 (FEI–1913) **Prospects of metallic fuel using in fast reactors.** Murogov, V.M.; Van'kov, A.A.; Ilyunin, V.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 63p. (In Russian). Order Number DE89633603/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Characteristics of metallic fuel are considered from the point of view of its possible application in fast-breader reactors of BN-type. State-of-the-art in developing and reactor testing of fuel elements with this fuel is analysed according to foreign publications. Fuel elements based on U-Pu-Zr alloy are shown to be efficient under economically acceptable thermal loads (~ 400-500 w/cm) at 630 deg C up to high burn-up (~ 10%). Physico-technical parameters of modern american designs for fast reactors of PRISM and SAFR-type are considered. These reactors are shown to have essential advantages against fast reactors of a traditional type both in economical factors and in safe-guarding. Nowdays investigations on developing fuel elements with metallic fuel go on increasingly. 54 refs.; 8 figs; 18 tabs.

40222 (FRNC-TH–3396) **Signals structural analysis and processing: application to acoustic signals recorded during sodium boiling in a nuclear reactor.** Rodriguez, J. CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Universite de Technologie de Compiegne, 60 (France). Feb 1986. 223p. (In French). Order Number DE89903305/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

An acoustic system that uses examples to learn the structure of specific signals linked to a corresponding class of physical phenomena, and classify an unknown signal (possibly with noise present) into one of the learned classes is presented. The first stage consists of smoothing the data. The signal is represented as a trace according to background and event. To learn the structures in each class, smoothed, segmented signals are used. For classification, three operations to modify the signal so that it perfectly verifies the model description are available.

40223 (HEDL-SA–3626) **FFTF [Fast Flux Test Facility] fuel handling experience (1979–1986).** Romrell, D.M.; Art, D.M.; Redekopp, R.D.; Waldo, J.B. Hanford Engineering Development Lab., Richland, WA (USA). May 1987. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76FF02170. (CONF-8709450–1: ANS/ENS international conference on fast breeder system, Kennewick, WA (USA), Sep 1987). Order Number DE89014953/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Fast Flux Test Facility (FFTF)is a 400 MW (th) sodium-cooled fast flux test reactor located on the Hanford Site in southeastern Washington State. The FFTF is operated by the Westinghouse Hanford Company for the United States Department of Energy. The FFTF is a three loop plant designed primarily for the purpose of testing full-scale core components in an environment prototypic of future liquid metal reactors. The plant design emphasizes features to enhance this test capability, especially in the area of the core, reactor vessel, and refueling system. Eight special test positions are provided in the vessel head to permit contact instrumented experiments to be installed and irradiated. These test positions effectively divide the core into three sectors. Each sector requires its own In-Vessel Handling Machine (IVHM) to access all the core positions. Since the core and the in-vessel refueling components are submerged under sodium, all handling operations must be performed blind. This puts severe requirements on the positioning ability are reliability of the refueling components. This report addresses the operating experience with the fuel handling system from initial core loading in November, 1979 through 1986. This includes 9 refueling cycles. 2 refs., 8 figs.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

Refer also to citation(s) 40449

2107 Regulation and Licensing

Refer also to citation(s) 40251, 40285, 40286, 40294

40224 (NUREG–0540-Vol.2-No.5) **Title list of documents made publicly available, May 1–31, 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1989. 393p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A17/MF A01 - GPO - OSTI.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List included the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS).

40225 (NUREG–0750-Vol.29-Index-1) **Indexes to Nuclear Regulatory Commission issuances, January–March 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1989. 48p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document.

40226 (NUREG–0750-Vol.29-No.5) **Nuclear Regulatory Commission issuances, May 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. May 1989. 75p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO - OSTI.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

40227 (NUREG–0940-Vol.8-No.1) **Enforcement actions: Significant actions resolved: Quarterly progress report, January–March 1989: Volume 8, No. 1.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement. Jun 1989. 425p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A19/MF A01 - GPO - OSTI.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (January–March 1989) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. Also included are a number of enforcement actions that had been previously resolved but not published in this NUREG. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

40228 (NUREG/CR–5152) **Comparison and regulatory impact of NQA-1 and NQA-2 with N45.2 QA standards.** Scanga, B.; Stokley, J. Nuclear Regulatory Commission, Washington, DC (USA); Science Applications International Corp., McLean, VA (USA). Jul 1989. 52p. Sponsored by Nuclear Regulatory Commission. (SAIC–88/3015). Available from NTIS, PC A04/MF A01 - GPO - OSTI.

This report compares the 1983 edition of ANSI/ASME NQA-1 and the 1986 edition of NQA-2 standards with the ANSI N45.2 series of QA standards. NQA-1 (1983) has been endorsed for design and construction by NRC by Revision 3 of Regulatory Guide 1.28. NQA-2 has not yet been formally endorsed by the NRC. Where differences between the two sets of standards exist, the authors have assessed the impact of these differences on the regulatory process. The analysis considers both NRC Regulatory Guide endorsements and current NRC emphasis on the performance-based inspection process. The reviewers find that the NQA standards are more focused on the technical aspects of products and processes to achieve quality as compared to N45.2 standards emphasis on program verification activities. In contrast to NQA-1, NQA-2 has incorporated many lessons learned during plant construction experience and the operations phase of nuclear facilities. The summary of the impact on regulations that is presented in this report provides a comparison for utilities, vendors, and NRC inspectors of existing standards. 38 refs.

2108 Economics

40229 (FRNC-R–305) **Capitalizing the contribution of the nuclear industry.** Donnadieu, G. Conseil Economique et Social, 75 - Paris (France). 1984. 230p. (In French). Order Number DE89903304/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

The main contributions of the French nuclear industry to the country, and ways to make the most of them are presented. The advantages acquired include the nuclear power stations built; mastering of the combustion cycle; a powerful, well structured nuclear construction industry; and a nuclear-industrial complex giving France an important industrial potential. It is recommended that the industrial and research effort be maintained. The proposed strategy consists of defining an electronuclear program and associated economic development program and sticking to them; promoting exports; possibly merging certain industrial capacities; and strengthening the national position and independence concerning the fuel cycle.

22 NUCLEAR REACTOR TECHNOLOGY

Refer also to citation(s) 40343

2201 Theory and Calculation

Refer also to citation(s) 40242

40230 (IKE–6-177) **Verification and adaptation of cross sections by measured results of integral experiments.** Baechle, R.D. Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme. Nov 1988. 102p. (In German). Order Number DE89795118/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

FORTRAN IV.

Increased demands of reactor safety and radiation protection require higher accuracies of cross sections in radiation penetration calculations. An improvement can be achieved by the adjustment of cross sections by deep penetration benchmark experiments. An iterative procedure is applied based on the least-square method. The program ADJUST-EUR has been made using the results of the one- and two-dimensional transport calculations with linear perturbation theory. Results of the adjustment in the 100 group EURLIB-structure are presented and discussed. (orig./HP).

40231 (INDC(JPN)–121-L) **Calculation of the delayed fission gamma-ray spectra from U-235, -238, Pu-239, -240 and Pu-241; Tabular Data.** Yoshida, T.; Katakura, J.I.; Ihara, H. Nuclear Energy Agency, 75 - Paris (France). Mar 1989. 42p. (NEANDC(J)–134-L). Order Number DE89903236/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The delayed fission-gamma-ray, which is emitted aggregatively from the unstable nuclides produced by fission, must be taken into account properly in calculation of the gamma-ray source in nuclear reactors. Despite its importance, the delayed gamma-ray data is not well organized nor prepared even in major nuclear data libraries such as JENDL and ENDF/B. Here we prepare the delayed gamma-ray spectra for five major fissioning nuclides. In calculating these spectra, theoretical estimation of the unknown spectra was carried out widely for a lot of no-data nuclides, which had been a major source of ambiguity in calculating the delayed gamma-ray spectra.

40232 (INIS-mf–11497) **Development and applications of the generalized bias operator method in nuclear calculations.** Navon, A. Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dec 1985. 193p. (In Hebrew). Order Number DE89633487/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

The uncertainties in the determination of nuclear performance parameters are derived from the uncertainties in the nuclear data, in the modeling techniques and in the calculation methods. The improvement of the performance parameters requires an excessive improvement of the analytic methodology as well as the construction of new and expensive experimental facilities. Recently a new method was suggested - The Generalized Bias Operator Method. A bias operator, obtained from the knowledge of the 'reference' values serves to improve the calculations of new systems similar to the 'reference' system. The present work was aimed to develop ways for the application of the generalized bias operator method in nuclear calculations. The generalized bias operator method was applied to three typical problems in reactor core calculations. The objective was to: (a) improve diffusion calculations with respect to transport calculations; (b) improve calculations performed with a small number of energy groups relative to those carried out with many energy groups; (c) replace two-dimensional calculations by several one-dimensional calculations. The calculated examples presented in this work show that the generalized bias operator method is a useful and efficient tool in reactor core calculations. This methodology can be used with existing codes with a minimum of modifications. Additionally, a comparison between the bias operator method and the bias factor method was performed. In general, there is a significant advantage in the application of the bias operator method relative to the bias factor method. 57 refs.

2202 Components and Accessories

Refer also to citation(s) 40273, 40687

40233 (EPRI-EL/NP/CS–5914-SR, pp. 21.1-21.9) **Cable condition monitoring research activities at Sandia National Laboratories.** Jacobus, M.J. (Sandia National Labs., Albuquerque, NM (USA)); Zigler, G.L.; Bustard, L.D. Electric Power Research Inst., Palo Alto, CA (USA). Jul 1988. DOE Contract AC04-76DP00789. (CONF-880299–: Workshop on power plant cable condition monitoring, San Francisco, CA (USA), 16-18 Feb 1988). In *Workshop on power plant cable condition monitoring: Proceedings.* Order Number DE88014886/JAW. Available from Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303.

Sandia National Laboratories is currently conducting long-term aging research on representative samples of nuclear power plant cables. The objectives of this program are to determine the suitability of these cables for extended life (beyond 40 year design basis) and to assess various cable condition monitoring techniques for predicting remaining cable life. The cables are being aged for long times at relatively mild exposure conditions with various condition monitoring techniques to be employed during the aging process. Following the aging process, the cables will be exposed to a sequential accident profile consisting of high dose rate irradiation followed by a simulated design basis loss-of-coolant accident (LOCA) steam exposure.

40234 (EPRI-NP–6075-SR) **Nondestructive Evaluation (NDE) research progress in 1988: Proceedings from the ninth annual EPRI NDE information meeting.** Avioli, M.J. Jr.; Dau, G.J.; Liu,

S.N.; Stein, J.; Welty, C.S. Electric Power Research Inst., Palo Alto, CA (USA); COE Corp., Mountain View, CA (USA). c May 1989. 401p. Sponsored by Electric Power Research Institute. (CONF-8811218–: 9. annual EPRI/NDE information meeting, Charlotte, NC (USA), 15-16 Nov 1988). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The increasing cost of equipment for power generating plants and the potential increases in productivity and safety analysis through rapidly developing Nondestructive Evaluation (NDE) technology led EPRI to initiate a Nondestructive Evaluation Program in 1974. To date, the major focus has been on light water reactor inspection problems; however, increased application to other systems is now underway. This report presents a comprehensive review of the EPRI effort in the NDE area. Most of the report consists of contractor-supplied progress reports on each current project. An organizational plan of the program is presented in overview. In addition, organization from several viewpoints is presented, e.g., in-service inspection operators, R and D personnel, and utility representatives. As the tenth in a planned series of annual progress reports of EPRI-funded NDE activities, this report also serves as the proceedings of the Ninth Annual EPRI NDE Information Meeting held in Charlotte, North Carolina, on November 15–16, 1988. It summarizes significant progress made since the previous EPRI Special Report NP-5490-SR was issued in June 1988. Section 1 contains information about the program organization, and the sections that follow contain contractor-supplied progress reports on each current project. The progress reports are grouped by plant components – pipe, pressure vessel, and steam generator and boiler tubes. In addition, Part 5 is devoted to discussions of technology transfer.

40235 (EPRI-NP–6444-Vol.1) **Guidelines for predicting the life of steam turbine disks exhibiting stress corrosion cracking: Volume 1, Resources: Final report.** Nair, P.K.; Lyle, F.F. Jr.; Buckingham, J.E.; Pennick, H.G. Electric Power Research Inst., Palo Alto, CA (USA); Southwest Research Inst., San Antonio, TX (USA). c Jul 1989. 175p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The investigators reviewed research on stress corrosion cracking under wet exposure conditions typical of the low-pressure turbine disk environment and reviewed methods for predicting remaining turbine life following detection of early stages of SCC. They developed several life-prediction approaches, each requiring different levels of analytic effort and case-specific data. The investigators established conservative generic representations of key variables, such as fracture toughness and crack growth rate, for application when more-accurate case-specific data are unavailable. Volume 1 reviews available data and evaluates the data's applicability to predicting turbine life. The report presents information on turbine disk design, duty cycles, and service stresses. It also describes analytic procedures for predicting turbine life; these procedures range from the very simple and conservative (level 1) to advanced finite-element techniques (level 3). 62 refs., 39 figs., 14 tabs.

40236 (INIS-mf–11498) **Thermodynamic analysis of cooling systems for nuclear power stations condenser.** Beck, A. Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering. Jun 1985. 155p. (In Hebrew). Order Number DE89633493/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

This work is an attempt to concentrate on the thermodynamic theory, the engineering solution and the quantities of water needed for the operation of a wet as well as a wet/dry cooling towers coupled to a nuclear turbine condenser,. About two hundred variables are needed for the design of a condenser - cooling tower system. In order to make the solution fast and handy, a computer model was developed. The amount of water evaporation from cooling towers is a function of the climate conditions prevailing around the site. To achieve an authentic analysis, the meteorological data of the northern Negev was used. The total amount of water necessary to add to the system in a year time of operation is large and is a function of both the blow-down rate and the evaporation. First estimations show that the use of a combined system, wet/dry cooling tower, is beneficial in the northern Negev area. Such a system can reduce significantly the amount of wasted fresh water. Lack of international experience is the major problem in the acceptability of wet/dry cooling towers. The technology of a wet cooling tower using sea water is also discussed where no technical or engineering limitations were found. This work is an attempt to give some handy tools for making the choice of cooling systems for nuclear power plants easier. 30 refs., tables and figures.

40237 (NUREG/CR–5383) **Effect of aging on response time of nuclear plant pressure sensors.** Hashemian, H.M.; Petersen, K.M.; Fain, R.E.; Gingrich, J.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Analysis and Measurement Services Corp., Knoxville, TN (USA). Jun 1989. 149p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A07/MF A01 - GPO - OSTI.

A research program was initiated to study the effects of normal aging on the dynamic performance of safety-related pressure transmitters in nuclear power plants. The project began with an experimental assessment of the conventional and new testing methods for measurement of response time of pressure transmitters. This was followed by developing a laboratory set up and performing initial tests to study the aging characteristics of representative transmitters of the type used in power plants. The project also included a search of the LER data base for pressure sensing system, problems and a review of the Regulatory Guide 1.118 and the industry standards on performance testing of pressure transmitters. The work reported herein was a feasibility study performed over a six-month period. As such, the results and conclusions presented herein are preliminary. 15 refs., 44 figs., 25 tabs.

40238 (PNL-SA–16162) **Estimation of fracture energy from fracture surface roughness.** Williford, R.E. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890721–36: Joint ASME/JSME pressure vessel and piping conference, Honolulu, HI (USA), 23-27 Jul 1989). Order Number DE89015836/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The fracture properties of engineering components or structural members can change during service. Post-failure estimation of these properties can be difficult and costly if the component is either contaminated (e.g., radioactive) or is too small to prepare reliable specimens for standard laboratory fracture tests. In either case, specimens are usually obtained from material that is a finite distance away from the actual fracture surface. This paper describes a method whereby the local fracture energy at the crack may be estimated from measurements of the fracture surface roughness, or from a replica of the surface. The method is based on fractals, and patenting is in progress at this writing. The advantages and current limitations of the method are described herein. 8 refs., 4 figs., 1 tab.

2203 Fuel Elements

Refer also to citation(s) 40210

40239 (AECL–8904) **Documentation and post-irradiation examination of Canadian nuclear fuel.** Truant, P.T.; MacDonald, R.D. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Sep 1985. 99p. (CONF-8509462–: IAEA co-ordinated research program on the examination and documentation methodology for water reactor fuel (ED-WARF), Vienna (Austria), 9-11 Sep 1985). Order Number DE89620262/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Canadian nuclear fuels includes fuels irradiated in CANDU power stations by our utilities and experimental fuels irradiated in the AECL-RC research reactors. Both types of fuel are documented with fabrication records, irradiation histories and power burnup logs. Many of these documents are generated by computer allowing individual fuel bundles and elements to be tracked from their delivery at the reactor to their final storage. Post-irradiation examination of our fuels takes place in underwater bays near the reactors and in shielded hot cells at AECL-Research Company (AECL-RC) laboratories using specialized equipment and techniques. Included in the fuel inspection procedures is a computer file for keeping examination records and a quality control system for shielded cell work. Most of the techniques, systems, codes and equipment used in documentation and in post-irradiation examination are illustrated in

the report by three actual fuel irradiations, an experimental test in our research reactors, high burnup fuel from the Bruce reactor and fuel from a failed Pickering fuel channel.

40240 (ECN–213) **Sphere-pac versus pellet UO_2 fuel in de Dodewaard BWR.** Linde, A. van der. Netherlands Energy Research Foundation, Petten (Netherlands). Apr 1989. 240p. Order Number DE89620228/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Comparative testing of UO_2 sphere-pac and pellet fuel rods under LWR conditions has been jointly performed by the Netherlands Utilities Research Centre (KEMA) in Arnhem, the Netherlands Energy Research Foundation (ECN) at Petten and the Netherlands Joint Nuclear Power Utility (GKN) at Dodewaard. This final report summarizes the highlights of this 1968-1988 program with strong emphasis on the fuel rods irradiated in the Dodewaard BWR. The conclusion reached is that under normal LWR conditions sphere-pac UO_2 in LWR fuel rods offers better resistance against stress corrosion cracking of the cladding, but that under fast, single step, power ramping conditions pellet UO_2 in LWR fuel rods has a better resistance against hoop stress failure of the cladding. 128 figs., 36 refs., 19 tabs.

40241 (FEI–1898) **Testing some recommendations on calculation of critical heat fluxes in rod assemblies.** Klochkova, L.F.; Sal'nikova, O.V.; Sapankevich, A.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 20p. (In Russian). Order Number DE89633505/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Various relations recommended by the Soviet and foreign authors for calculating critical heat fluxes in rod assemblies with uniform heat release are considered. Analysis of experimental data file, including 8222 points, is conducted. Operating and geometrical parameters of the assemblies are the following 0.981-196MPa pressure, 47-4500 kg/m^{2}xs mass flow rate, 5-16 mm rod diameter 1.02-1.60 relative rod spacing, 3-37 number of rods in an assembly. It is shown that Macbeth relation provides for the best results. 17 refs.; 4 figs.; 3 tabs.

2204 Control Systems

40242 (ANL-FRA–165) **Engineering physics production code implementation on the Cray X-MP.** Adams, C.H.; Derstine, K.L.; Toppel, B.J. Argonne National Lab., IL (USA). 29 Mar 1989. 49p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. Order Number DE89014161/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document describes Engineering Physics Division software designed to ease transition to the Cray X-MP computer and to provide support in the long term for a multi-computer environment for batch reactor analysis calculations. These activities include development of Unicos scripts to provide easier access to the new system, implementation of the File Transfer Utility FTU which provides format conversion of binary files between the Cray and other computer systems, and development of a modular environment analogous to the system which has been in use on the Argonne IBM computer system for many years. 10 refs., 14 figs., 3 tabs.

40243 (CONF-890555–18) **Experience with model based display for advanced diagnostics and control.** Staffon, J.D.; Lindsay, R.W. Argonne National Lab., Idaho Falls, ID (USA). 1989. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 7. power plant dynamics, control and testing symposium; Knoxville, TN (USA); 15-17 May 1989. Order Number DE89015693/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A full color, model based display system based on the Rankine thermodynamic cycle has been developed for use at the Experimental Breeder Reactor II by plant operators, engineers, and experimenters. The displays generate a real time thermodynamic model of the plant processes on computer screens to provide a direct indication of the plant performance. Operators and others who view the displays are no longer required to mentally "construct" a model of the process before acting. The model based display accurately depicts the plant states. It appears to effectively reduce the gulf of evaluation, which should result in a significant reduction in human operator errors if this plant display approach is adopted by the nuclear industry. Preliminary comments from users, including operators, indicate an overwhelming acceptance of the display approach. The displays incorporate alarm functions as well as levels of detail "paging" capability. The system is developed on a computer network which allows the easy addition of displays as well as extra computers. Constructing a complete console can be rapid and inexpensive. 1 ref., 2 figs.

40244 (CONF-890555–19) **Development and application of diagnostic systems to achieve fault tolerance.** King, R.W.; Singer, R.M. Argonne National Lab., Idaho Falls, ID (USA). 1989. 21p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 7. power plant dynamics, control and testing symposium; Knoxville, TN (USA); 15-17 May 1989. Order Number DE89015692/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Much work is currently being done to develop and apply diagnostic systems that are tolerant to faulted conditions in the process being monitored and in the sensors that measure the critical parameters associated with the process. A fault-tolerant diagnostic system based on state-determination, pattern-recognition techniques is currently undergoing testing and evaluation in certain applications at the EBR-II reactor. Testing and operational experience with the system to date has shown a high degree of tolerance to sensor failures, while being sensitive to very slight changes in the plant operational state. This paper briefly mentions related work being done by others, and describes in more detail the pattern-recognition system and the results of the testing and operational experience with the system at EBR-II. 9 refs., 10 figs.

40245 (CONF-890555–20) **Plant automation: EBR-II experience and future plans with GE PRISM.** Christensen, L.J.; Sackett, J.I.; Dayal, Y.; Wagner, W.K. Argonne National Lab., Idaho Falls, ID (USA). 1989. 5p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 7. power plant dynamics, control and testing symposium; Knoxville, TN (USA); 15-17 May 1989. Order Number DE89015162/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Work is on-going at EBR-II in the development and demonstration of new control equipment and methods and associated schemes for plant prognosis, diagnosis, and automation. The development work has attracted the interest of other national laboratories, universities, and commercial companies. New initiatives include use of new control strategies, expert systems, advanced diagnostics, and operator displays. The unique opportunity offered by EBR-II is as a test bed where a total integrated approach to automatic reactor control can be directly tested under real power plant conditions. EBR-II is an integral part of Argonne National Laboratory's commitment to the design, development and testing of advanced LMR concepts. This includes a closed-loop fuel cycle, where EBR-II spent fuel is reprocessed and recycled back into the reactor. Presently the fuel reprocessing facility is undergoing major modifications that include total automatic control systems for all of the in-cell processes. EBR-II has made significant progress in the conversion from analog PID controllers to networked computer based control systems. The work is continuing to convert the plant to a supervisory control system. The effort to convert to a computer based control system allows EBR-II to continue operation with a high plant factor and also allows cooperative control system effort to be conducted with universities and with GE PRISM.

40246 (CONF-890555–21) **Application of advanced technology to LMR control.** Lindsay, R.W. Argonne National Lab., IL (USA). 1989. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 7. power plant dynamics, control and testing symposium; Knoxville, TN (USA); 15-17 May 1989. Order Number DE89015695/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Key issues must be resolved to preserve the nuclear option; including new considerations for safety, economics, waste, transportation, diversion, etc. The programs at the Experimental Breeder Reactor II (EBR-II) are now carefully focused to provide answers to

the above concerns in connection with the Integral Fast Reactor program at Argonne. Safety features that are inherent in plant design, coupled with automating plant control to help achieve the above objectives are more than just an issue of installing controllers and exotic algorithms, they include the complete integration of plant design, control strategy, and information presentation. Current technology development, both at Argonne and elsewhere includes efforts relating to the use of Artificial Intelligence, sensor/signal validation in many forms, pattern recognition, optimal develop and/or adopt promising technologies, and integrate them into an operating power plant for proof of value. After they have proven useful at EBR-II, it is expected that they can be incorporated into advanced designs such as PRISM and/or included in backfit activities as well. 6 refs.

40247 (CONF-890555–22) **Multifrequency tests in the EBR-II reactor plant.** Feldman, E.E.; Mohr, D.; Gross, K.C. Argonne National Lab., IL (USA). 1989. 14p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 7. power plant dynamics, control and testing symposium; Knoxville, TN (USA); 15-17 May 1989. Order Number DE89015694/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A series of eight multifrequency tests was conducted on the Experimental Breeder Reactor II. In half of the tests a control rod was oscillated and in the other half the controller input voltage to the intermediate-loop-sodium pump was perturbed. In each test the input disturbance consisted of several superimposed single-frequency sinusoidal harmonics of the same fundamental. The tests are described along with the theoretical and practical aspects of their development and design. Samples of measured frequency responses are also provided for both the reactor and the power plant. 22 refs., 5 figs., 2 tabs.

40248 (CONF-890673–4) **Recent advances in control and diagnostics development and application.** Monson, L.R.; King, R.W.; Lindsay, R.W.; Staffon, J.D. Argonne National Lab., Idaho Falls, ID (USA). 1989. 13p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From IWGFR specialists meeting on advanced controls for fast reactors; Argonne, IL (USA); 20-22 Jun 1989. Order Number DE89015133/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The power industry is undergoing rapid technological advances and cultural changes. Technologies are advancing and evolving so rapidly that the industry is hard pressed to keep up and take full advantage of the many developments now in progress. Recent advantages in state-of-the-art computer technology are making inroads in the form of advanced computer control, expert systems, on-line performance monitoring and diagnostics. Validation and verification schemes are being developed which provide increased confidence in the correctness and reliability of both computer hardware and software. Our challenge in the nuclear community is to effectively apply these new technologies to improve the operation, safety, and reliability of our plants. This presentation discusses two areas of development that are essential to advanced control strategies: application of diagnostic systems to improve fault-tolerance, and model-based graphic displays. 4 refs., 4 figs.

40249 (CONF-890899–1) **Use of expert systems in nuclear power plants.** Uhrig, R.E. Oak Ridge National Lab., TN (USA). 1989. 23p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From Joint Korea-United States seminar on expert systems for electric power systems and industries; Seoul (Republic of Korea); 13-18 Aug 1989. Order Number DE89015064/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The application of technologies, particularly expert systems, to the control room activities in a nuclear power plant has the potential to reduce operator error and increase plant safety, reliability, and efficiency. Furthermore, there are a large number of nonoperating activities (testing, routine maintenance, outage planning, equipment diagnostics, and fuel management) in which expert systems can increase the efficiency and effectiveness of overall plant and corporate operations. This document presents a number of potential applications of expert systems in the nuclear power field. 36 refs., 2 tabs.

40250 (HEDL-SA–3712) **Reactivity anomalies in the FFTF [Fast Flux Test Facility]: An evaluation of data from Cycles 1 through 8.** Knutson, B.J.; Harris, R.A. Hanford Engineering Development Lab., Richland, WA (USA). Apr 1987. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76FF02170. (CONF-8704383–1: American Nuclear Society (ANS) topical meeting, Kennewick, WA (USA), Apr 1987). Order Number DE89014943/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Experience using an automated core reactivity monitoring technique at the Fast Flux Test Facility (FFTF) through eight operating cycles is described. This technique relies on comparing predicted to measured rod positions to detect any anomalous (or unpredicted) core reactivity changes. Reactivity worth predictions of core state changes (e.g., temperature and irradiation changes) and compensating control rod movements are required for the rod position comparison. A substantial data base now exists to evaluate changes in temperature reactivity feedback effects operational in the FFTF, rod worth changes due to core loading, temperature and irradiation effects and burnup effects associated with transmutation of fuel materials. This report summarizes preliminary work of correlating zero power and at-power rod worth measurement data, calculated burnup rates and rod worths using the latest ENDF/B-V cross section set for each cycle to evaluate the prediction models and attempt to resolve observed reactivity anomalies. 2 figs., 2 tabs.

40251 (NUREG–1218) **Regulatory analysis for resolution of USI [Unresolved Safety Issue] A-47: Safety implications of control systems in LWR [light-water reactor] nuclear power plants: Final report.** Szukiewicz, A.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Jul 1989. 40p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

This report presents a summary of the regulatory analysis conducted by the US Nuclear Regulatory Commission staff to evaluate the value/impact of alternatives for the resolution of Unresolved Safety Issue A-47, "Safety Implications of Control Systems." The NRC staff's resolution presented herein is based on these analyses and on the technical findings and conclusions presented in NUREG-1217, the companion document to this report. The staff has concluded that certain actions should be taken to improve safety in light-water reactor plants. The staff recommended that certain plants improve their control systems to preclude reactor vessel/steam generator overfill events and to prevent steam generator dryout, modify their technical specifications to verify operability of such systems, and modify selected emergency procedures to ensure safe shutdown of the plant following a small-break loss-of-coolant accident. This report was issued as a draft for public comment on May 27, 1988. As a result of the public comments received, this report was revised. The NRC staff's responses to and resolution of the public comments are included as Appendix C to the final report, NUREG-1217.

2205 Environmental Aspects

Refer also to citation(s) 39975, 40856, 40868, 40869, 40889, 40894, 40901, 40919, 40960

40252 (CONF-8906182–1) **The Integral Fast Reactor concept: Today's hope for tomorrow's electrical energy needs.** Dwight, C.C.; Phipps, R.D. Argonne National Lab., Idaho Falls, ID (USA). 1989. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From Society of Women Engineers national annual meeting; Oakland, CA (USA); 27 Jun - 2 jul 1989. Order Number DE89016633/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Acid rain and the greenhouse effect are getting more attention as their impacts on the environment become evident around the world. Substantial evidence indicates that fossil fuel combustion for electrical energy production activities is a key cause of those problems. A change in electrical energy production policy is essential to a stable, healthy environment. That change is inevitable, it's just a matter of when and at what cost. Vision now, instead of reaction later, both in technological development and public perception, will help to limit the costs of change. The Integral Fast Reactor (IFR) is a visionary concept developed by Argonne National Laboratory that involves electrical energy production through fissioning of heavy metals by

fast neutrons in a reactor cooled by liquid sodium. Physical characteristics of the coolant and fuel give the reactor impressive characteristics of inherent and passive safety. Spent fuel is pyrochemically reprocessed and returned to the reactor in the IFR's closed fuel cycle. Advantages in waste management are realized, and the reactor has the potential for breeding, i.e., producing as much or more fuel than it uses. This paper describes the IFR concept and shows how it is today's hope for tomorrow's electrical energy needs. 14 refs., 1 fig., 1 tab.

40253 (EPRI-NP–6454) **Radionuclide correlations at TMI-2 for 10 CFR 61 compliance.** Deltete, C.P.; Hofstetter, K.J. Electric Power Research Inst., Palo Alto, CA (USA); Analytical Resources, Inc., Sinking Spring, PA (USA); GPU Nuclear Corp., Middletown, PA (USA). c Jul 1989. 146p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A detailed review and evaluation of all radionuclide analysis results from the TMI-2 waste has helped develop scaling factors for difficult to measure radionuclides. Analytic procedures and results from this research are applicable to waste classification for other sites involving higher-than-normal fuel leakage. Individual utilities and industry organizations, including EPRI, are developing waste classification programs to comply with NRC regulation 10 CFR 61, implemented in December 1983. Much of this effort has focused on the use of scaling factors to correlate the presence of difficult-to-measure radionuclides (Tc-99, C-14, Ni-63, I-129, and transuranics) with nuclides more readily measured in power reactor waste streams (such as Co-60 and Cs-137). Researchers have invariably concluded that the quantifiable results are insufficient to establish defensible scaling factors for some radionuclides, such as I-129 and Tc-99. The TMI-2 cleanup operations have yielded more data, with more observable radionuclide, than previous waste classification efforts. The additional data on 10 CFR 61 radionuclide correlations provided through characterizations of the TMI-2 waste may prove beneficial to a broad sector of the industry. 22 figs., 9 tabs.

40254 (GA-A–19674) **MHTGR [Modular High Temperature Gas-Cooled Reactor] radionuclide source terms for use in siting.** Inamati, S.B.; Neylan, A.J.; Silady, F.A. General Atomics, San Diego, CA (USA). Jun 1989. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC03-89SF17885. (CONF-8906184–1: IAEA technical committee meeting on gas-cooled reactor technology, safety and siting, Dimitrovgrad (USSR), 21-23 Jun 1989). Order Number DE89015091/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper presents the site suitability source terms for the Modular High Temperature Gas-Cooled Reactor (MHTGR). The MHTGR program has identified a spectrum of accident release scenarios that form a basis for determining the MHTGR site suitability source terms. This basis, consistent with 10CFR100 guidelines, includes an evaluation of a spectrum of accidents to determine a set of conservative source terms. The spectrum of accidents is represented by a set of Licensing Basis Events (LBEs). The subset of LBEs that involve radionuclide release from the plant is identified. The MHTGR approach evaluates site suitability with respect to the regulatory criteria applicable not only for off-normal events, but also for normal operation and emergency planning. The radionuclide inventories available for potential release from the MHTGR and the release behavior of these inventories are characterized. A summary of the source terms for selected key radionuclides are given. The time-dependent MHTGR source terms account for a mix of accident phenomena, failure states of barriers, number of reactor modules, and chemical attack conditions that are consistent with the unique characteristics of the MHTGR. 7 refs., 1 fig., 4 tabs.

40255 (INIS-mf–11482) **Environmental impact of operation of uranium industry and of nuclear power plants (1475C sem.). Collection of abstracts.** Ceska Vedeckotechnicka Spolecnost, Prague (Czechoslovakia). Komise pro Jadernou Techniku. 11 Nov 1988. 9p. (In Czech, Slovak). (CONF-8811240–: Environmental impact of operation of uranium industry and of nuclear power plants, Prague (Czechoslovakia), 10 Nov 1988). Order Number DE89631288/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Papers presented on environmental control in the areas of in-situ uranium mining (northern Bohemia), the assessment of the contamination of the environment in Czechoslovakia following the Chernobyl disaster, the possibilities of the endangerment of the environment in the surroundings of radioactive waste depositories, the optimization of ecological costs of the operation of nuclear power plants, the evaluation of the potential impact of the Kecerovce nuclear power plant on ground water quality, the model calculation of food contamination in the power plant surroundings. An evaluation is made of the possibility of gaining scintific information for personnel of the Czechoslovak nuclear program. (E.S.).

40256 (INIS-XE–1) **Iodine filters in nuclear installations.** Wilhelm, J.G. Commission of the European Communities, Luxembourg (Luxembourg). 1982. 209p. Order Number DE89903253/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The present report discusses the significance for environmental exposure of the iodine released with the gaseous effluents of nuclear power stations and reprocessing plants in relation to releases of other airborne radionuclides. Iodine filtration processes are described. The release pathways and the composition of airborne fission product iodine mixtures and their bearing on environmental exposure are discussed on the basis of measured fission product iodine emissions. The sorbents which can be used for iodine filtration, their removal efficiencies and range of applications are dealt with in detail. The particular conditions governing iodine removal, which are determined by the various gaseous iodine species, are illustrated on the basis of experimentally determined retention profiles. Particular attention is given to the limitations imposed by temperature, humidity, radiation and filter poisoning. The types of filter normally used are described, their advantages and drawbacks discussed, the principles underlying their design are outlined and the sources of error indicated. The methods normally applied to test the efficiency of various iodine sorbents are described and assessed. Operating experience with iodine filters, gathered from surveillance periods of many years, is supplemented by a large number of test results and the findings of extensive experiments. Possible ways of prolonging the permissible service lives of iodine filters are discussed and information is given on protective measures. The various iodine removal processes applied in reprocessing plants are described and compared with reference to efficiency and cost. The latest developments in filter technology in reprocessing plants are briefly outlined.

40257 (INIS-XE–2) **Retention of radioactive noble gases in nuclear power stations by means of activated charcoal delay systems. A status report.** Schroeder, H.J. Commission of the European Communities, Luxembourg (Luxembourg). 1983. 74p. Order Number DE89903255/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Since the beginning of the 1970s off-gas systems using activated charcoal have been used in BWRs and PWRs to minimize the release of radioactive noble gases and the resultant exposure of the environment. In practice, the power-related noble gas emission rate achieved is 1-10 Ci/MWa in the case of BWRs and 0.1-1 Ci/MWa for PWRs. The systems are relatively simple in design and operators state that they are easy and cheap to run. The activated charcoal used shows no signs of becoming spent and, if protected from humidity, retains its full efficiency. On the basis of the information to hand it has never been necessary to replace it. Experience to date suggests that a charge of activated charcoal can last the life of the facility as a whole. All knowledge and experience gained so far indicate that off-gas systems using activated delay systems for BWR facilities are indispensable and must therefore be considered an integral part of such facilities. Capital expenditure amounts to approximately 1% of the total cost and should, therefore, not be unacceptable. In PWRs off-gas systems using pressure vessels as delay trains are in competition with off-gas systems based on activated charcoal delay systems. The activated charcoal systems have proved themselves and their use, which involves capital expenditure equivalent to approximately of 0.5% to the overall cost, can be recommended without reservation.

40258 (INIS-XE–3) **Radioactive effluents from nuclear power stations and nuclear fuel reprocessing plants in the European Community Discharge data 1976 to 1980 radiological**

aspects. Luykx, F.; Fraser, G. Commission of the European Communities, Luxembourg (Luxembourg). 1983. 106p. Order Number DE89903256/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The report covers operational nuclear power stations of capacity greater than 5C MWe and nucler fuel reprocessing plants in the European Community. Radioactive gaseous and liquid effluent discharges from these installations are given for the period 1976 to 1980, expressed both in absolute terms and normalized to net electricity production from the fuel. An assesssment is then made of exposure of members of the public consequent to the 1980 discharges. Where environmental contamination levels were detectable the results have been taken into account in the dose assessment; however, environmental contamination was in general below the limit of detection. In these circumstances the dose estimates rely entirely on theoretical models which frequently incorporate conservative assumptions; hence these estimates are likely to be greater than the doses actually received. The estimated exposures have then been compared with the dose limits set out in the Euratom Directive of 15th July, 1980. It is concluded that the exposure of members of the public always left an appreciable safety margin relative to the limits and indeed lay within the variations in exposure which result from natural background.

40259 (SNV–3532) **Biological and radioecological investigations at the Ringhals nuclear power station, 1968-1987. A summary.** Grimaas, U.; Jacobsson, A.; Neuman, E. National Swedish Environmental Protection Board, Solna (Sweden). Sep 1989. 26p. Order Number DE89795244/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The summary is based on 19 papers, which are presented in the References. The reports concern fish, bottom-living animals, zooplankton and algae as well as the presence of radioactivity in the aquatic and terrestrial environments. The investigation has been conducted at the request of Vaesterbygden's Water Rights Court and present the experiences of twelve operational years, of which the last four years have been with the power station at full capacity. In judging the effects of the operation of the power station, particular emphasis has been placed on questions given priority by the Water Rights Court, namely fishing and radioactivity. As regards fishing, the direct effects of the cooling-system on fish in different developmental stages have been assessed to be of importance. Water-borne radioactivity has been traced in organisms and sediment in the area. The concentrations of different radionuclides originating from the power station are highest in algae and lowest in fish-meat. The results form the basis of calculations of the radioactive dose to man. (orig./HP).

40260 (YJT–89-01) **Geophysical borehole methods in fracture analysis of crystalline bedrock of the Loviisa site.** Rouhiainen, Pekka. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). Apr 1989. 117p. (TKK-DISS–695). Order Number DE89632949/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The aim of this study is to develope interpretation methods to determine fracture porosity and directional properties of water filled fracture space in crystalline bedrock. Geophysical methods with high spatial resolution along the borehole are chosen for the study. This enables the analysis of individual fractures. The analyzed methods are the dipmeter, sonic log, and bed resolution density log. The spatial resolution of the sonic log is improved with a convolution filter. The proposed method for fracture aperture analysis utilizes peak values of anomalies. Equal area projection is used for visual presentation of the fracture porosity and directional properties of fracture space. A tensor presentation with probability correction is applied for matemathical presentation of fracture properties. The material for the study is from the investigations of the Loviisa nuclear power plant site in Finland. The results from the site reveal that fracture aperture is unevenly distributed. The fracture porosity tensor is strongly oriented to horizontal direction. Comparison with hydraulic tests indicated that the total fracture porosity is one or two orders of magnitude larger than the hydraulically determined effective flow porosity or kinematic porosity.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 40202, 40275

40261 (AECL–9720) **District heating with SLOWPOKE energy systems.** Lynch, G.F. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Mar 1988. 28p. (In English, French). (CONF-8804283–: 3. Korea Atomic Industrial Forum/Korea Nuclear Society joint annual conference, Seoul (Republic of Korea), 18-20 Apr 1988). Order Number DE89620244/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included.

The SLOWPOKE Energy System, a benign nuclear heat source designed to supply 10 thermal megawatts in the form of hot water for local heating systems in buildings and institutions, is at the forefront of these developments. A demonstration unit has been constructed in Canada and is currently undergoing an extensive test program. Because the nuclear heat source is small, operates at atmospheric pressure, and produces hot water below 100 degrees Celcius, intrinsic safety features will permit minimum operator attention and allow the heat source to be located close to the load and hence to people. In this way, a SLOWPOKE Energy System can be considered much like the oil- or coal-fired furnace it is designed to replace. The low capital investment requirements, coupled with a high degree of localization, even for the first unit, are seen as attractive features for the implementation of SLOWPOKE Energy Systems in many countries.

40262 (FEI–1894) **Calculational and experimental studies of non-stationary neutron distribution in pulsed experiments in the BFS-40 critical assembly with account for higher harmonics range.** Romanov, V.M.; Pupko, V.Ya.; Gushchina, T.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 18p. (In Russian). Order Number DE89633617/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Experimental and calculational studies of non-stationary neutron distribution in the BFS-40 critical assembly are made in order to investigate laws of occurrence and existence range of neutron flux harmonics. Neutron pulsed method is used in the experiments. Calculations of the damping factors of higher harmonics are conducted using the MMKFK program complex. Three energy harmonics are separated as a result of experimental study. The same ones are obtained by means of calculations. Calculational and experimental results are in a good agreement. 20 refs.; 2 figs.; 3 tabs.

40263 (NIIAR–2(733)) **Capsules for graphite sample irradiation in the SM-2 reactor up to high neutron fluences.** Shulimov, V.N.; Mel'der, R.R.; Grachev, V.D.; Lobanov, G.P. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1988. 16p. (In Russian). Order Number DE89633618/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Capsules for graphite sample irradiation up to (1-2)x$10^{26}$$m^{-2}$ fluence in equipped and non-equipped channels of the SM-2 reactor, as well as technique of thermal-physical calculations are described. In-pile test results, demonstrating good agreement of calculational and experimental data, are presented. 3 refs.; 5 figs.; 2 tabs.

40264 (NRCN–576) **Computation of research reactors loaded with MTR and Caramel types of fuel.** Misulovin, A.; Schneider, A. Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev. Dec 1988. 36p. (In Hebrew). Order Number DE89633491/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The neutronic computational system that operates at NRCN for the analysis of thermal reactors, is tested by comparing calculated parameters of research reactors fueled with MTR or Caramel fuels with those obtained in other research centers. (author).

2209 Reactor Safety

Refer also to citation(s) 40223, 40227, 40228, 40237, 40243, 40244, 40248, 40249, 40251, 40252, 40254, 40343, 40686, 40868, 40888, 40890, 40891, 40892, 40895, 40899, 41015

40265 (BNL-NUREG–42533) **Preliminary reactor cavity melt dispersal model for direct containment heating scenarios.** Ginsberg, T.; Tutu, N.K. Brookhaven National Lab., Upton, NY (USA). 1989. 14p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890819–14: ASME/AIChE national heat transfer conference, Philadelphia, PA (USA), 6-9 Aug 1989). Order Number DE89011252/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents the results of a series of experiments performed to study the effect of initial pressure vessel conditions on the extent of melt dispersal from scaled reactor cavities and describes progress in development of a mathematical model which is designed to predict the melt mass dispersed from reactor cavities as a function of reactor vessel initial conditions and on the vessel breach area. The model, which is being developed to also characterize the heat transfer and chemical reaction phenomena which would take place within the reactor cavity, is designed to be incorporated into a lumped-parameter containment analysis computer code.

40266 (BNL-NUREG–42676) **Integrated system for seismic evaluations.** Xu, J.; Philippacopoulos, A.J.; Miller, C.A.; Costantino, C.J.; Graves, H. Brookhaven National Lab., Upton, NY (USA). 1989. 5p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890855–40: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89012670/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes the various features of the Seismic Module of the CARES system (Computer Analysis for Rapid Evaluation of Structures). This system was developed by Brookhaven National Laboratory (BNL) for the US Nuclear Regulatory Commission to perform rapid evaluations of structural behavior and capability of nuclear power plant facilities. The CARES is structured in a modular format. Each module performs a specific type of analysis i.e., static or dynamic, linear or nonlinear, etc. This paper describes the features of the Seismic Module in particular. The development of the Seismic Module of the CARES system is based on an approach which incorporates all major aspects of seismic analysis currently employed by the industry into an integrated system that allows for carrying out interactively computations of structural response to seismic motions. The code operates on a PC computer system and has multi-graphics capabilities. It has been designed with user friendly features and it allows for interactive manipulation of various analysis phases during the seismic design process. The capabilities of the seismic module include (a) generation of artificial time histories compatible with given design ground response spectra, (b) development of Power Spectral Density (PSD) functions associated with the seismic input, (c) deconvolution analysis using vertically propagating shear waves through a given soil profile, and (d) development of in-structure response spectra or corresponding PSD's. It should be pointed out that these types of analyses can also be performed individually by using available computer codes such as FLUSH, SAP, etc. The uniqueness of the CARES, however, lies on its ability to perform all required phases of the seismic analysis in an integrated manner. 5 refs., 6 figs.

40267 (BNL-NUREG–42677) **High level vibration test of nuclear power piping: Overall plan, input motion development and analysis.** Hofmayer, C.H.; Curreri, J.R.; Park, Y.J.; Kato, W.Y.; Costello, J.F.; Tang, H.T.; Kawakami, S. Brookhaven National Lab., Upton, NY (USA). 1989. 6p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890855–44: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89012671/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

As part of cooperative agreements between the United States and Japan, tests have been performed on the seismic vibration table at the Tadotsu Engineering Laboratory of Nuclear Power Engineering Test Center (NUPEC) in Japan. The tests involved increasing the excitation up to the limits of the vibration table in order to induce inelastic response in a reactor coolant system piping model. The model was subjected to a maximum acceleration well beyond what nuclear power plants are designed to withstand. The High Level Vibration Test (HLVT) model was constructed by modifying the 1/2.5 scale model of one loop of a PWR primary coolant system which was previously tested by NUPEC as part of their seismic proving test program. The upper and middle steam generator shell supports of the model, which simulated the actual plant condition, were removed and the steam generator shell was truncated. Furthermore, the four lower support columns for the steam generator were replaced by a pin-type support. A modified earthquake excitation was used to drive the structure to a condition of substantial strain. Since the piping was pressurized, and the high level input motion was repeated several times, it was possible to investigate the effects of ratchetting and fatigue as well. An isometric view of the test model and support frame is shown in Figure 1. Further details of the hot leg pipe are shown in Figure 2. The piping in the model is stainless steel, 14-15 inches in diameter and 1 to 1 1/4 inches thick. This paper describes the overall plan, the input motion development and pre-test analysis results. 4 refs., 8 figs., 1 tab.

40268 (CEA-DAS–588) **Probabilistic assessment of SGTR management.** Champ, M.; Cornille, Y.; Lanore, J.M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Apr 1989. 5p. (CONF-890405–: PSA '89: international topical meeting on probability, reliability and safety assessment, Pittsburgh, PA (USA), 2-7 Apr 1989). Order Number DE89903193/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In case of steam generator tube rupture (SGTR) event, in France, the mitigation of accident relies on operator intervention, by applying a specific accidental procedure. A detailed probabilistic analysis has been conducted which required the assessment of the failure probability of the operator actions, and for that purpose it was necessary to estimate the time available for the operator to apply the adequate procedure for various sequences. The results indicate that by taking into account the delays and the existence of adequate accidental procedures, the risk is reduced to a reasonably low level.

40269 (CEA-DAS–589) **Application of fire models for risk analysis in french nuclear power plants.** Brauns, P.; Grouset, D.; Rebuffat, D.; Vachon, M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Apr 1989. 13p. (CONF-890203–: IAEA international symposium on fire protection and fire fighting at nuclear installations, Vienna (Austria), 27 Feb - 3 mar 1989). Order Number DE89903138/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Numerical simulations of compartment fires have been carried out in the French 900 MW and 1 300 MW nuclear power plants, to obtain quantitative data about this particular kind of risk: characteristic spreading times from one redundant electrical train to the other one, behaviour of important electrical components... The main stages of both studies were the following: selection of rooms, the location or function of which are essential for the plant safety in case of fire, on-site inspections to collect information about these rooms (amount of fuel, openings...), definition of fire scenarios, improvement of the fire model VESTA-PLUS, and, finally calculations using this computer code. The simulations have shown two major trends: (i) the spreading times, without taking into account any external intervention, are always greater than half an hour, and (ii) the specific design of the 1 300 MW power plants generally prevents one of the redundant train from being damaged due to a fire occurring in a room containing the other one. Examples of typical results obtained are given, showing the capability of application of the improved fire model to complex problems.

40270 (CONF-890855–9) **Response of HDR-VKL piping system to seismic test excitations: Comparison of analytical predictions and test measurements.** Srinivasan, M.G.; Kot, C.A.; Hsieh, B.J. Argonne National Lab., IL (USA). 1989. 13p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89009782/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As part of the earthquake investigations at the HDR (Heissdampfreaktor) Test Facility in Kahl/Main, FRG, simulated seismic tests (SHAM) were performed during April–May 1988 on the VKL (Versuchskreislauf) piping system. The purpose of these experiments

was to study the behavior of piping subjected to a range of seismic excitation levels including those that exceed design levels manifold and that might induce failure of pipe supports or plasticity in the pipe runs, and to establish seismic margins for piping and pipe supports. Data obtained in the tests are also used to validate analysis methods. Detailed reports on the SHAM experiments are given elsewhere. The objective of this document is to evaluate a subsystem analysis module of the SMACS code. This module is a linear finite-element based program capable of calculating the response of nuclear power plant subsystems subjected to independent multiple-acceleration input excitation. The evaluation is based on a comparison of computational results of simulation of SHAM tests with corresponding test measurements.

40271 (EPRI-NP–6432) **Application of the Reactor Analysis Support Package LWR set-point analysis guidelines.** Engel, R.E.; Sorensen, J.M.; May, R.S.; Doran, K.J.; Trikouros, N.G.; Mozzias, E.S. Electric Power Research Inst., Palo Alto, CA (USA); Levy (S.), Inc., Campbell, CA (USA); GPU Nuclear Corp., Parsippany, NJ (USA). c Jul 1989. 400p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Frequently, a situation is encountered in which the technical specification setpoints established by the plant safety analysis are judged to be unacceptable from a plant operational standpoint. This report documents the application of the Electric Power Research Institute (EPRI) Reactor Analysis Support Package (RASP) Light Water Reactor (LWR) setpoint analysis guidelines to provide justification for relaxing the high pressure setpoints at the Oyster Creek Nuclear Generation Station. More Specifically, the plant operation's staff determined that it was desirable to provide increased margin for measurement uncertainties in the high pressure instrument and safety valve setpoints. Previous experience had indicated that there was insufficient margin to justify the desired setpoints using conventional deterministic inputs to the safety analysis and plant performance evaluation process. Therefore, it was determined that the RASP LWR setpoint analysis guidelines, which incorporated the use of a statistical combination of uncertainties methodology, would be used to establish an acceptable set of high pressure setpoints. This report documents the results of applying the RASP setpoint analysis guidelines to provide justification for an acceptable set of high pressure setpoints for the Oyster Creek station. 14 refs., 53 figs., 28 tabs.

40272 (EPRI-NP–6434) **Interim guidelines for protecting fire-fighting personnel from multiple hazards at nuclear plant sites: Final report.** Klein, A.R.; Bloom, C.W. Electric Power Research Inst., Palo Alto, CA (USA); Yankee Atomic Electric Co., Bolton, MA (USA); ENRG, Inc., Chelmsford, MA (USA). c Jul 1989. 32p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report provides interim guidelines for reducing the impact to fire fighting and other supporting emergency response personnel from the multiple hazards of radiation, heat stress, and trauma when fighting a fire in a United States commercial nuclear power plant. Interim guidelines are provided for fire brigade composition, training, equipment, procedures, strategies, heat stress and trauma. In addition, task definitions are provided to evaluate and further enhance the interim guidelines over the long term. 19 refs.

40273 (EPRI-NP–6443) **Improved criteria for snubber functional testing: Final report.** Olson, D.E.; Won, S.W.; Wipasuramonton, P. Electric Power Research Inst., Palo Alto, CA (USA); Sargent and Lundy, Chicago, IL (USA). c Jul 1989. 83p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The objective of this study is to provide guidelines for improved piping acceptance criteria for functional testing of snubbers during in-service inspection. The study addresses how increased limits for snubber drag and motion limits affect piping response. These guidelines are intended to assist in the development of plant-specific piping acceptance criteria. Examples are provided to illustrate how improved piping acceptance limits expected to have an insignificant effect on piping response. 17 refs., 22 figs., 13 tabs.

40274 (EUR–11995) **Study and optimization of filter systems for separating dusts and aerosols produced in layers concrete decontamination.** Ebeling, W.; Rose, K. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 63p. (In German). Available from NTIS (US Sales Only), PC A04/MF A01.

When nuclear power plants finally shut down are dismantled, contaminated surface layers of buildings must be removed, if it is not intended to dismantle and store the entire structure. The removal of the concrete in layers produces considerable amounts of dust and aerosols, which must be separated as completely as possible. The aim of the project was to find filter systems for economic separation of this dust. A literature study showed that cleanable filters have advantages in comparison with other methods of separation. For this reason, three cleanable filters were investigated during the course of this research project in tests using inactive concrete samples. Separation levels of over 99.9 % could be achieved with all tested filters. Furthermore, the effectiveness of one filter was demonstrated in decontamination operations. The manufacturers guarantee useful lives of 2,000 operating hours for the tested filters. The costs of the separation of the dust are negligible in comparison with the expenditure for the removal of the concrete layers, the subsequent conditioning and the disposal.

40275 (FEI–1888) **Completing of the stochastic theory for a point zero power reactor.** Volkov, Yu.V.; Nazarov, V.K. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 39p. (In Russian). Order Number DE89633485/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

General model of a branching process with several particle types and immigration, describing time behaviour of reactor neutron population, is constructed. Equations for generating and characteristic functions of neutron number distribution in reactor are obtained. These equations form the basis for deriving relations for evaluation of nuclear accident probability, stochastic differential equations of reactor point kinetics relations for evaluating probabilistic characteristics of nuclear accident aftereffects, as well as for evaluation of correctness of the known Hansen, Cohen and Fooks models. 12 refs.; 2 figs.

40276 (FRCEA-TH–187) **Water boiling kinetic in rapid decompression.** Sekri, A. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France); Strasbourg-1 Univ., 67 (France). 1982. 290p. (In French). Order Number DE89903168/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

This study entering in the frame of a CEA, EDF and Framatome collaboration, has for objective to modelize two-phase flows in case of PWR Loca. The objective is to find, by taking in account the all imbalances, a formulation for the mass transfer at the interface water-vapor by the study of water boiling phenomenon in case of fast decompression such as a primary circuit break. In this accident, the estimation of boiling speeds in an essential parameter for determining the break discharge which conditions the safety systems design.

40277 (GA-A–19713) **Modeling of fission product release from HTR [high temperature reactor] fuel for risk analyses.** Bolin, J.; Verfondern, K.; Dunn, T.; Kania, M. General Atomics, San Diego, CA (USA). Jul 1989. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC03-89SF17885. (CONF-890810–2: Seminar on small and medium sized reactors, design, safety and marketing potential, San Diego, CA (USA), 21-23 Aug 1989). Order Number DE89015750/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The US and FRG have developed methodologies to determine the performance of and fission product release from TRISO-coated fuel particles under postulated accident conditions. The paper presents a qualitative and quantitative comparison of US and FRG models. The models are those used by General Atomics (GA) and by the German Nuclear Research Center at Juelich (KFA/ISF). A benchmark calculation was performed for fuel temperatures predicted for the US Department of Energy sponsored Modular High Temperature Gas Cooled Reactor (MHTGR). Good agreement in the benchmark calculations supports the on-going efforts to verify and validate the independently developed codes of GA and KFA/ISF. This work was

performed under the US/FRG Umbrella Agreement for Cooperation on Gas Cooled Reactor Development. 6 refs., 3 figs., 3 tabs.

40278 (INIS-mf–11502, pp. 9-16) **Global impact of the Chernobyl accident.** Goldman, M. (University of California, (USA)). Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The pattern of radioactive release from the Chernobyl nuclear reactor accident that began in April 1986 has been analyzed to provide estimates of possible future health effects in exposed populations. Appropriate environmental transport models were used to integrate data from affected countries in order to estimate present and future distributions of radiation doses to pertinent population groups. Based on the most recent risk projection methodology, estimates of possible increases in cancer mortality, in teratogenic effects and in genetic effects have been derived from these dose projections for population groups in the USSR, the United States of America and other regions in the northern hemisphere. The significanct findings are described. The estimates of potential health impacts in the northern hemisphere as a result of the radioactive release from the Chernobyl accident are also given in a table.

40279 (INIS-mf–11502, pp. 56-57) **Deposition velocity choice for hazard evaluation.** Skibin, D. (Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev). Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40280 (KFK–4493) **Development of a simulator modul for the CORA experiment to be used within the SFD code SCDAP.** Hering, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektgruppe LWR-Sicherheit. Apr 1989. 75p. (In German). Order Number DE89795006/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Out-of-pile experiments on Severe Fuel Damage (SFD) of LWR fuel elements are performed in the CORA facility. Additionally to the experimental investigations, calculations are done using the Severe Core Damage Analysis Package (SCDAP). To calculate CORA experiments with this code, which was originally designed for in-pile use, a new module has been introduced into SCDAP, to simulate the electric heater rod of the CORA test bundle. The new modul is composed of features to calculate radial and axial properties and the axial temperature dependent power profile. Especially the autocatalytic feedback of the tungsten heater has been considered carefully. The extension of the axial boundaries to the cold ends of the heater rod was necessary to calculate the power balance observed in the experiment. The extended SCDAP code uses a 2-dimensional heat conduction in the heated section of the bundle and a 1-dimensional model in the non-heated sections in the electrode sections of the bundle. The power release and the temperatures in the heated area are comparable to the results of the CORA tests as far as classical thermohydraulics are involved. (orig./HP).

40281 (KFKI–1989-02/G) **Use of pressurizer spray line in order to minimize loop-seal effects.** Perneczky, L.; Toth, I.; Szabados, L. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Jan 1989. 49p. (In Hungarian). Order Number DE89633850/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

During a SBLOCA in WWER-440 reactors the simultaneous formation of loop seals in both the hot and the cold legs can have detrimental effects on core cooling. A RELAP4/mod6 calculation of a 7.4% break case was performed in order to investigate whether the pressurizer spray line could act as a relief for steam trapped in the hot parts by loop seals. The results showed no significant influence on fuel cladding temperatures following the opening of the spray line. (author) 12 refs.; 36 figs.

40282 (NUREG/CP–0097-Vol.1, pp. 1-4) **Nuclear safety research - a vital role in achieving nuclear safety.** Zech, L.W. Jr. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The author discusses the importance of the Nuclear Regulatory Commission's (NRC) nuclear safety research program and the direction of the NRC research program through the mid-1990's. The primary objective of the program is to characterize the overall level of safety of operating nuclear power plants. Regarding this objective the following topics are discussed: Individual Plant Examination (IPE) program; Reactor Safety Study (WASH-1400); validation of safety margins set forth by current regulations; improvement of plant performance; reactor operator training; human factors; plant aging; materials research; and containment loading. The second objective of the agency to which the research program must be directed is to provide a regulatory framework which will facilitate the development and licensing of standard LWR plants and development and deployment of improved LWR concepts. The broader scope of the program related to the fuel cycle, transportation, radioactive waste management, and safeguards is briefly mentioned.

40283 (NUREG/CP–0097-Vol.1, pp. 5-9) **Overview of the Nuclear Regulatory Commission's safety research program.** Beckjord, E.S. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

Accomplishments during 1988 of the Office of Nuclear Regulatory Research and the program of safety research are highlighted, and plans, expections, and needs of the next year and beyond are discussed. Topics discussed include: ECCS Appendix K Revision; pressurized thermal shock; NUREG-1150, or the PRA method performance document; resolution of station blackout; severe accident integration plan; nuclear safety research review committee; and program management.

40284 (NUREG/CP–0097-Vol.1, pp. 33-46) **Effectiveness and safety aspects of selected decontamination methods for LWRs recontamination experience 1988.** Duce, S.W. (EG and G Idaho Inc., Idaho Falls (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC07-76ID01570. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

This paper presents information on the recontamination of recirculation piping in commercial boiling water reactors following successive chemical decontaminations or pipe replacement. Several types of pipe pre-treatments have been used at different facilities where the recirculation pipe were replaced to reduce the rate at which radionuclides were incorporated into the oxide films on the inner pipe surfaces. These pipe treatments are briefly discussed and net contamination control effects of the treatments are compared. Net contamination control effects of successive chemical decontaminations on non-replaced pipe is also discussed.

40285 (NUREG/CP–0097-Vol.1, pp. 141-162) **Potential application of NRC aging research to license renewal.** Vora, J.P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

A strong technical base, when developed and implemented, to manage aging in plant safety related systems, support systems, structures, and components will give confidence to all of them in the nuclear community toward the continuous safe operation of nuclear power plants of all ages. The following specific Nuclear Plant Aging Research programs, implemented by the Division of Engineering of the Office of Nuclear Regulatory Research, address the technical safety issues related to aging and will provide the technical bases for the development of regulatory guides and review procedures for license renewal applications. These programs are (1) risk significance of component aging and prioritization, (2) hardware-oriented engineering programs for electrical and mechanical components, safety systems, and support systems; primary system pressure boundary components and materials and nondestructive examination; and civil structures, (3) reviews of technical specifications from the standpoint of aging, (4) development of guidance for record-keeping to track and evaluate aging impacts, (5) residual lifetime evaluation and development of guidance for aging mitigation of large LWR components and structures, and (6) development of regulatory guides and review procedures for license renewal applications. This paper provides an overview of the intended application of plant aging research results. In the process it delineates some key steps recommended for the development of appropriate regulatory guides and review procedures involving the technical issues for license renewal considerations.

40286 (NUREG/CP–0097-Vol.1, pp. 171-184) **Industry initiatives in support of license renewal.** DelGeorge, L.O. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The US commercial nuclear power industry has made many pioneering contributions since its inception in the 1950's. The world has followed this industry's lead in designing a power source that is safe, reliable, and economical. One of today's great challenges is to successfully blaze new pioneering trails into the frontiers of plant aging. As was the case in the 1950's, and perhaps more so today, the full realization of the economic life of their power production facilities - mindful, of course, of the public safety - is both the challenge and the mandate presented to us. The stakes are high and objectively understandable. All new things age. If the aging process is not understood and to the extent possible controlled, the benefits of the aged resource are lost. Studies have shown that such losses could amount to more than half of this country's nuclear power capacity between the years 2010 and 2025. The replacement cost of that loss would be staggering - in the hundreds of billions of dollars. Action to mitigate these losses in necessary and is being taken by the nuclear industry. Beginning in the mid-1970's and escalating to the present, US electric utilities have considered the affects of aging on their power production assets, both fossil and nuclear. This paper reviews the history of the nuclear industry effort and describe its present focus and outlook.

40287 (NUREG/CP–0097-Vol.1, pp. 191-202) **Methods to understand the influence of management factors on performance reliability.** Haber, S.B. (Brookhaven National Lab., Upton, NY (USA)); O'Brien, J.N. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

It was the purpose of the project to develop the methods to be used in the assessment of supervisory and management factors on safety performance in a nuclear power plant and to provide a product useful to Nuclear Regulatory Commission personnel, nuclear power plant personnel, and probabilistic risk assessment practitioners. The methods developed in this project provide one means of conceptualizing the human dynamics of a nuclear power plant organization. The model (NOMAM) is descriptive, yet process-oriented and allows for the identification of key supervisory and management influences on plant performance through the evaluation of organizational processes. Examination of standardization processes is critical in understanding the functional dynamics of a nuclear power plant. Behavioral factors unique to supervisory and management influences have been identified, and the actual collection of behavioral data from a nuclear power plant will allow a direct interface with risk and reliability studies.

40288 (NUREG/CP–0097-Vol.1, pp. 203-208) **Safety system function trends.** Johnson, C. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

This paper describes research to develop risk-based indicators of plant safety performance. One measure of the safety-performance of operating nuclear power plants is the unavailability of important safety systems. Brookhaven National Laboratory and Science Applications International Corporation are evaluating ways to aggregate train-level or component-level data to provide such an indicator. This type of indicator would respond to changes in plant safety margins faster than the currently used indicator of safety system unavailability (i.e., safety system failures reported in licensee event reports). Trends in the proposed indicator would be one indication of trends in plant safety performance and maintenance effectiveness. This paper summarizes the basis for such an indicator, identifies technical issues to be resolved, and illustrates the potential usefullness of such indicators by means of computer simulations and case studies.

40289 (NUREG/CP–0097-Vol.1, pp. 209-218) **Selection of anchor values for human error probability estimation.** Buffardi, L.C. (George Mason Univ., Fairfax, VA (USA)); Fleishman, E.A.; Allen, J.A. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

There is a need for more dependable information to assist in the prediction of human errors in nuclear power environments. The major objective of the current project is to establish guidelines for using error probabilities from other task settings to estimate errors in the nuclear environment. This involves: (1) identifying critical nuclear tasks, (2) discovering similar tasks in non-nuclear environments, (3) finding error data for non-nuclear tasks, and (4) establishing error-rate values for the nuclear tasks based on the non-nuclear data. A

key feature is the application of a classification system to nuclear and non-nuclear tasks to evaluate their similarities and differences in order to provide a basis for generalizing human error estimates across tasks. During the first eight months of the project, several classification systems have been applied to a sample of nuclear tasks. They are discussed in terms of their potential for establishing task equivalence and transferability of human error rates across situations.

40290 (NUREG/CP–0097-Vol.1, pp. 243-252) **USI A-45, shutdown decay heat removal.** Woods, R. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

This paper describes the resolution of USI A-45 through planned plant-specific analyses under the Individual Plant Evaluation (IPE) program. The technical basis for this resolution includes important insights gained from decay heat removal risk assessments for six operating reactors. These studies, together with the operating history of decay heat removal (DHR) failures, have led to the conclusions that: (1) risk due to loss of DHR could be unduly high for some plants; (2) DHR failure vulnerabilities, and the optimum corrective actions for those vulnerabilities, are strongly plant specific; and (3) detailed plant specific analyses under the IPE program, including anticipated future extension of the IPE program which will require consideration of externally initiated events, will be needed to resolve this issue.

40291 (NUREG/CP–0097-Vol.1, pp. 265-278) **Automatic isolation of auxiliary feedwater.** Basdekas, D.; Bruske, S.J.; Welland, H.J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

Generic Issue 125.II.7 was evaluated to determine if the disadvantages of the automatic auxiliary feedwater system (AFW) isolation system, such as reduced AFW system reliability, outweighed the benefits provided by automatic AFW isolation to a steam generator during a steam or feed line break accident. Reactor plants with automatic AFW isolation systems from each pressurized water reactor (PWR) vendor were evaluated by determining the automatic isolation system's contribution to the core damage frequency (CDF) and determining any CDF increase or decrease that would occur if the system were removed. The CDF changes were used to estimate the change to the consequences or public risk due to removing the isolation system. Recent probabilistic risk assessments (PRAs) for a reactor plant from each PWR vendor were used to quantify the changes to CDFs and risks. The findings of this study indicate that the automatic AFW isolation system does not contribute significantly to the CDF or public risk for any of the plants evaluated. Removing the AFW isolation system resulted in a slight decrease in CDF and risk in some plants and caused a slight increase in CDF and risk in others.

40292 (NUREG/CP–0097-Vol.1, pp. 279-292) **Emergency diesel generator reliability program.** Serkiz, A.W. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The need for an emergency diesel generator (EDG) reliability program has been established by 10 CFR Part 50, Section 50.63, Loss of All Alternating Current Power, which requires that utilities assess their station blackout duration and recovery capability. EDGs are the principal emergency ac power sources for coping with a station blackout. Regulatory Guide 1.155, Station Blackout, identifies a need for (1) an EDG reliability equal to or greater than 0.95, and (2) an EDG reliability program to monitor and maintain the required levels. The resolution of Generic Safety Issue (GSI) B-56 embodies the identification of a suitable EDG reliability program structure, revision of pertinent regulatory guides and Tech Specs, and development of an Inspection Module. Resolution of B-56 is coupled to the resolution of Unresolved Safety Issue (USI) A-44, Station Blackout, which resulted in the station blackout rule, 10 CFR 50.63 and Regulatory Guide 1.155, Station Blackout. This paper discusses the principal elements of an EDG reliability program developed for resolving GSI B-56 and related matters.

40293 (NUREG/CP–0097-Vol.1, pp. 293-298) **Reactor coolant pump seal failures.** Jackson, J.E. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

Failures of reactor coolant pump (RCP) seals that could result in a loss-of-coolant accident (LOCA) are of current concern to the Nuclear Regulatory Commission (NRC). This could occur either where leakage through the seals exceeded the capacity of the normal makeup systems, as has occurred in operating plants, or under station blackout conditions where loss of seal cooling represents a common mode failure for all RCPs. The purpose of Generic Issue 23 Reactor Coolant Pump Seal Failures is to evaluate the adequacy of current licensing requirements relating to RCP seal integrity and to determine if further NRC action is necessary to assure that RCP failures and seal auxiliary system failures do not pose an unacceptable risk. The status of the resolution of the issue, the major sources of information for resolving Generic Issue 23, and the three alternative resolutions being evaluated are discussed in this paper.

40294 (NUREG/CP–0097-Vol.1, pp. 299-306) **Integration of generic issues.** Thatcher, D. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The NRC has recognized the need to integrate generic issues (GIs). The GI process includes a number of phases, all of which should recognize the potential for overlap and conflict among related issues. In addition to the issues themselves, other related NRC and industry programs and activities need to be factored into the GI process. Integration has taken place, or is taking place, for a number of GIs. Each case of integration involves a specific set of circumstances and, as a result, the way in which integration proceeds can vary. This paper discusses the integration of issues in the generic issue process and provides a number of examples.

40295 (NUREG/CP–0097-Vol.1, pp. 307-328) **Value-impact assessment of potential upgrades to control room annunciators.** Higgins, J. (Brookhaven National Lab., Upton, NY (USA)); Crouch, D.; Luckas, W.J. Jr. Nuclear Regulatory Commission, Washington,

DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

A human factors analysis was performed to assess the importance of identified upgrades or improvements to nuclear power plant control room annunciators. The effect of these upgrades on human performance during accident scenarios was also analyzed, and a value-impact assessment was performed.

40296 (NUREG/CP–0097-Vol.1, pp. 329-346) **Development of a PRA Models and Results Data Base.** Fink, D.J. (Idaho National Engineering Lab., Idaho Falls (USA)); Sattison, M.B. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC07-76ID01570. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The Nuclear Regulatory Commission's Office of Nuclear Regulatory Research (NRC-RES) is currently funding the development of the PRA Models and Results Data Base (PRA-DB) at the Idaho National Engineering Laboratory (INEL). The initial prototype is completely personal computer (PC)-based and provides a menu-driven user interface. The PRA-DB's primary functions are to serve as a data repository and data manager for NUREG-1150 data and other permanent probabilistic risk assessment (PRA) data, and to provide conversion capabilities on data utilized by the Integrated Reliability and Risk Analysis System (IRRAS), the System Analysis and Risk Assessment (SARA) system, the Set Equation Transformation System (SETS) and the Top Event Matrices Analysis Code (TEMAC). The PRA-DB manages the transfer and storage of data between the mainframe and PC codes. Having logic models, failure rate data, minimal cut sets and other PRA-related information available in a readily accessible form allows different analysts to perform studies on the same plants starting with the same baseline PRA information.

40297 (NUREG/CP–0097-Vol.1, pp. 347-372) **Value impact analysis utilizing PRA techniques combined with a hybrid plant model.** Edson, J.L. (Idaho National Engineering Lab., Idaho Falls (USA)); Stillwell, D.W. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

A value impact analysis (VIA) has been performed by the INEL to support a NRC Regulatory Analysis for resolution of Generic Issue (GI) 29, Bolting Degradation or Failure in Nuclear Power Plants. A VIA for replacing the reactor coolant pressure boundary (RCPB) bolts of BWRs and PWRs was previously prepared by Pacific Northwest Laboratories in 1985 under instructions limiting the VIA to the potential for failure of primary pressure boundary bolting. Subsequently the INEL was requested to perform a VIA that included non primary systems and component support bolts to be compatible with the resolution of the broader issue. Because the initial list of systems and bolting applications that could be included in the VIA was very large, including them all in the VIA would likely result in analyzing some that have little if any effect on public risk. This paper discusses how PRA techniques combined with a hybrid plant model were used to determine which bolts have the potential to be significant contributors to public risk if they were to fail, and therefore were included in the VIA.

40298 (NUREG/CP–0097-Vol.1, pp. 373-392) **IRRAS 2.0 - more than a fault tree code.** Russell, K.D. (EG and G Idaho, Inc., Idaho Falls (USA)); Sattison, M.B.; Rasmuson, D. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC07-76ID01570. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The Integrated Reliability and Risk Analysis System (IRRAS) is being developed at the Idaho National Engineering Laboratory (INEL) as the US Nuclear Regulatory Commission's (NRC's) state-of-the-art microcomputer-based probabilistic risk assessment (PRA) model development and analysis tool to address key nuclear plant safety issues. IRRAS is an integrated PRA software tool that gives the user the ability to create and analyze fault trees and accident sequences using an IBM-PC. This program provides functions that range from graphical fault tree construction to cut set generation and quantification. Also provided in the system is an integrated full-screen editor for use when interfacing with remote mainframe computer systems. The INEL role in the IRRAS program is that of software developer and interface to the user community, including training and technology transfer. IRRAS has all the capabilities and functions required to create, modify, reduce, and analyze fault tree models used in the analysis of complex systems and processes. IRRAS uses advanced graphic and analytical techniques to achieve the greatest possible realization of the potential of the microcomputer. When the needs of the user exceed this potential IRRAS can call upon the power of the mainframe computer. Version 2.0 of IRRAS provides all of the same capabilities as Version 1.0 and adds a relational data base facility for managing the data, improved functionality, and improved algorithm performance.

40299 (NUREG/CP–0097-Vol.1, pp. 393-404) **Impacts of multiplant actions on plant risk.** Reilly, H.J. (EG and G Idaho, Inc., Idaho Falls (USA)); Fowler, R.D.; Welland, H.J.; Mancuso, C.; Agrawal, B.B. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

Idaho National Engineering Laboratories (INEL) has established a program that estimates the effects of Multiplant Actions (MPAs) on plant risk. In this program, NRC data bases are accessed to acquire status information on each MPA that has been imposed but not yet implemented at each plant, and details of the imposition for the plant. An available Probabilistic Risk Assessment (PRA) of the plant is then used to analyze the effect that implementation of the MPA is expected to have no the best-estimate core damage frequency (CDF) for the plant. The analyses are documented and loaded into the data base of a PC program called the Multiplant Action Evaluation Display System (MEDS). The user of the PC can view or print any of the files in this data base. Experience with development of MPA Evaluations indicates that acquisition of files from the NRC data bases can be accomplished with reasonable ease using a PC with a modem. Some MPAs may be close enough to implementation that evaluations may be inappropriate. Some MPAs do not lend themselves to evaluations by PRA methods, because they are administrative issues or they involve possible occurrences or failure modes that were not within the scope of the available PRA. For these MPAs, only a text screen is prepared for MEDS. The results of the MPA Evaluation Program provide a perspective on the value of generic issue resolutions at operating nuclear power plants. They

also provide a perspective on the usefulness of PRAs for such purposes.

40300 (NUREG/CP–0097-Vol.1, pp. 405-416) **NRC research in common-cause failures.** Mitchell, D.B. (Sandia National Labs., Albuquerque, NM (USA)); Parry, G.W.; Paula, H.M.; Whitehead, D.W.; Rasmuson, D.M. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC04-76DP00789. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The status and recent history of common-cause failure (CCF) research are briefly reviewed. Current NRC research in the area of CCFs is described with emphasis on the remaining problem areas. These include deficiencies in data and the need to more completely understand the characteristics of CCFs. The concepts and relationships of root cause, coupling mechanisms, and defensive mechanisms are discussed. Key definitions and some in-depth analysis of these concepts are included. An overview of the recent research to be published is presented. This research includes the following (1) the cause-defense methodology for analyzing CCFs, (2) guidelines for identifying potential CCFs as part of a nuclear power plant walkdown and procedures review, and (3) requirements for an industry-wide data base, including documentation of failure events and additional component failure and failure mode data requirements to support future PRAs.

40301 (NUREG/CP–0097-Vol.1, pp. 469-480) **ALWR - regulatory stabilization through simplicity, margin, and improved safety.** Vine, G. (Electric Power Research Institute, Palo Alto, CA (USA)); Gray, S. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The Electric Power Research Institute Advanced Light Water Reactor (ALWR) program is discussed with respect to the following topics: fundamental acceptance criteria for the ALWR; program approach; utility steering committee technical guidance; safety principles; utility requirements document; design bases; generic safety issue resolution; reactor accidents prevention and mitigation; and programmatic plans.

40302 (NUREG/CP–0097-Vol.1, pp. 541-548) **Use of artificial intelligence to enhance the safety of nuclear power plants.** Uhrig, R.E. (Oak Ridge National Lab., TN (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC05-84OR21400. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

In the operation of a nuclear power plant, the sheer magnitude of the number of process parameters and systems interactions poses difficulties for the operators, particularly during abnormal or emergency situations. Recovery from an upset situation depends upon the facility with which the available raw data can be converted into and assimilated as meaningful knowledge. Plant personnel are sometimes affected by stress and emotion, which may have varying degrees of influence on their performance. Expert systems can take some of the uncertainty and guesswork out of their decisions by providing expert advice and rapid access to a large information base. Application of artificial intelligence technologies, particularly expert systems, to control room activities in a nuclear power plant has the potential to reduce operator error and improve power plant safety and reliability.

40303 (NUREG/CP–0097-Vol.1, pp. 549-561) **Overview of the contain LMR code.** Carroll, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC04-76DP00789. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The use of containments in proposed US Liquid Metal Reactors (LMR) will require that a computational tool be available for safety analysis. As a result of an international cooperative effort, such a tool has been produced in the CONTAIN-LMR computer code. This is a version of the CONTAIN code that has been enhanced with extra capabilities for LMR applications. CONTAIN is the NRC's best-estimate code for the evaluation of the conditions that may exist inside a reactor containment building during a severe accident. Included in the phenomena modeled are thermal-hydraulics, radiant and convective heat transfer, aerosol loading and transient response, fission product transport and heating effects, and interactions of sodium and corium with the containment atmosphere and structures. CONTAIN-LMR includes models for sodium-concrete interactions, debris bed phenomena and other LMR-specific models in an integrated manner. This paper summarizes the current state of CONTAIN-LMR. A brief description of the physical models is presented. As an example of model integration in CONTAIN-LMR, recent work on the debris bed models will be discussed. Recent applications of CONTAIN-LMR are discussed.

40304 (NUREG/CR–4674-Vol.7) **Precursors to potential severe core damage accidents: 1987: A status report: Main report and appendix A.** Minarick, J.W.; Harris, J.D.; Cletcher, J.W.; Austin, P.N.; Blake, A.A. Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Programs. Jul 1989. 135p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NOAC–232-Vol.7). Available from NTIS, PC A07/MF A01 - GPO - OSTI.

Forty-eight operational events ranking 1.0×10^{-6} or higher and 16 lesser events, reported in 3490 licensee event reports (LERs) and revisions and occurring at commercial light-water reactors during 1987, are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of earlier work, which evaluated the 1969–1981 and 1984–1986 events. The report discusses (1) the general rationale for this study, (2) the selection and documentation of events as precursors, (3) the estimation and use of conditional probabilities of subsequent severe core damage to rank precursor events, and (4) the plant models used in the evaluation process.

40305 (NUREG/CR–4674-Vol.8) **Precursors to potential severe core damage accidents: 1987: A status report: Appendixes B, C, and D.** Minarick, J.W.; Harris, J.D.; Cletcher, J.W.; Austin, P.N.; Blake, A.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Programs; Oak Ridge National Lab., TN (USA). Jul 1989. 741p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NOAC–232-Vol.8). Available from NTIS, PC A99/MF A01 - GPO - OSTI.

Forty-eight operational events ranking 1.0×10^{-6} or higher and 16 lesser events, reported in 3490 licensee event reports (LERs) and revisions and occurring at commercial light-water reactors during 1987, are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of earlier work, which evaluated the 1969–1981 and 1984–1986 events. The report discusses (1) the general rationale

for this study, (2) the selection and documentation of events as precursors, (3) the estimation and use of conditional probabilities of subsequent severe core damage to rank precursor events, and (4) the plant models used in the evaluation process.

40306 (NUREG/IA–0015) **Assessment of interphase drag correlations in the RELAP5/MOD2 and TRAC-PF1/MOD2 codes.** Ardron, K.H.; Clare, A.J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Central Electricity Generating Board, Barnwood (UK). Generation Development and Construction Div. Jul 1989. 32p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

An assessment is carried out of the interphase drag correlations used in modelling vertical two-phase flows in the advanced thermal hydraulic codes RELAP5/MOD2 and TRAC-PF1/MOD1. The assessment is performed by using code models to calculate void fraction in fully developed steam-water flows, and comparing results with predictions of standard correlations and test data. The study is restricted to the bubbly and slug flow regimes (void fractions below 0.75). For upflows, at pressures of interest in PWR small break LOCA and transient analysis the performance of the code models is generally satisfactory. Exceptions are (i) small hydraulic diameter channels at low pressures ($p \leq 4$ MPa) (ii) large pipe diameters at void fractions exceeding 0.5; in these cases void fraction errors are outside normal uncertainty ranges. For downflows, the code models give good agreement with limited available void fraction data. The numerical results given in this paper allow a rapid estimate to be made of void fraction errors likely to arise in a particular code application due to deficiencies in interphase drag modelling. 13 refs., 6 figs.

40307 (NUREG/IA–0016) **Assessment of RELAP5/MOD2, Cycle 36.04 against FIX-II guillotine break experiment No. 5061.** Eriksson, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Swedish Nuclear Power Inspectorate, Stockholm (Sweden). Jul 1989. 85p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A05/MF A01 - GPO - OSTI.

The FIX-II guillotine break experiment No. 5061 has been analyzed using the RELAP5/Mod2 code. The code version used, Cycle 36.04, is a frozen version of the code. Four different calculations were carried out to study the sensitivity of initial coolant mass, junction options and break discharge line modalization. The differences between the calculations and the experiment have been quantified over intervals in real time for a number of variables available from the measurements during the experiment. The break mass flows were generally underpredicted at the same time as the depressurization rate was overpredicted. 9 refs., 7 figs., 8 tabs.

40308 (NUREG/IA–0017) **Assessment of TRAC-PF1/MOD1 against a loss-of-grid transient in Ringhals 4 power plant.** Sjoberg, A.; Almberger, J.; Sandervag, O. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Swedish Nuclear Power Inspectorate, Stockholm (Sweden). Jul 1989. 57p. Sponsored by Nuclear Regulatory Commission. (STUDSVIK-NP–87/10). Available from NTIS, PC A04/MF A01 - GPO - OSTI.

A loss of grid transient in a three loop Westinghouse PWR has been simulated with the frozen version of TRAC-PF1/MOD1 computer code. The results reveal the capability of the code to qualitatively predict the different pertinent phenomena and the data comparison was quite encouraging. Accurate predictions of the system response required careful determination of the boundary conditions simulating the turbine governor valves and steam dump valves behaviour. An explicit modeling of the steam generator internals was also found to be important for the results. It was also revealed that the pressurizer system including spray and heaters and their operation should be modeled in some detail for proper response. 4 refs., 18 figs.

40309 (NUREG/IA–0020) **Assessment study of RELAP5/MOD2, CYCLE 36.04 based on spray start-up test for DOEL-4.** Moeyaert, P.; Stubbe, E. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; TRACTEBEL, Brussels (Belgium). Jul 1989. 420p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A18/MF A01 - GPO - OSTI.

This report presents an assessment study for the code RELAP-5 MOD-2 based on a pressurizer spray start-up test of the Doel-4 power plant. Doel-4 is a three loop WESTINGHOUSE PWR plant ordered by the EBES utility with a nominal power rating of 1000 MWe and equipped with preheater type E steam generators. A large series of commissioning tests are normally performed on new plants, of which the so called pressurizer spray and heater test (SU-PR-01) was performed on February 2nd 1985. TRACTEBEL, being the Architect-Engineer for this plant was closely involved with all start-up tests and was responsible for the final approval of the tests.

40310 (ORNL/TM–10971, pp. 157-168) **Vinten exposure measurements of the Salem Unit 1 lower core barrel.** Glennon, P.T. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

On November 6, 1987, the lower core barrel of Salem Unit I was removed from the reactor vessel and placed in the refueling pool as part of the unit's ten year inspection program. This paper deals with the supporting actions of the dosimetry group of PSE&G. Prior to the move of the lower core barrel, Westinghouse predicted dose rates at one foot in water as a function of axial distance along the core barrel. This prediction was used in planning the health physics requirements associated with the move. It was agreed that a measurement of the axial dose rates would either lend confidence to the predictions or identify weaknesses in them.

40311 (ORNL/TM–10971, pp. 169-178) **Dosimetry of an in-core detector exposure accident.** Olin, M. (Innsbrook Technical Center, Glen Allen, VA (USA)); Power, V.; Bartlett, W.T. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

Three technicians at the Surry Nuclear Power Station were exposed to high radiation levels from an activated cable while manually extracting a stuck in-core detector. The actual positioning of the detector was unknown and cable activation was not anticipated. As the activated cable entered the work platform area, exposure rates exceeded 1000 R/hr. The primary cable activity was found to be Mn-56 in a shielded line source geometry. The positioning of the individuals, shielding, short exposure times and unusual instrument responses created difficulties in dose assessment. The calculational methodologies and resulting dose assignments are discussed.

40312 (ORNL/TM–10971, pp. 179-189) **Estimating radiation doses from reactor accidents.** Jeffries, A.; Mohseni, A. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

In order to plan for emergency response to reactor accidents involving large radiation releases, it is necessary to determine the medical resources, such as diagnostic laboratory tests, hospital facilities and convalescent care, needed to care for a large population exposed to radiation. A determination of the needed medical resources is difficult because of the widely varying sensitivity humans exhibit to radiation exposure and because of the large number of assumptions involved in predicting radiation dispersion. This paper demonstrates a simple method for approximating medical needs in response to a severe reactor accident. The method requires a model for radiation dispersion from the accident and data for population distribution surrounding the reactor. With this information, tables developed in this paper may be used to project medical needs. The needs identified by this methodology may be compared against the actual medical resources of nearby communities to determine the size of the area impacted.

40313 (RTS-R–003) **RBMKs and Chernobyl-4.** Haslam, R.J. UKAEA Risley Technical Services, Risley (UK). Jun 1988. 37p. Available from H.M. Stationery Office, London, price Pound 10.00.

Outline information is given on RBMK power plants - the USSR's RBMK programme, the design of Chernobyl-4, the accident at Chernobyl-4 and measures taken to improve RBMK safety. The RBMKs are graphite-moderated reactors with pressure-tube channels for the fuel. The reactor coolant is high-pressure water which boils as it passes through the fuel channels. A fundamental characteristic of an RBMK core is that it has a positive void coefficient. This is normally overcome by the control system but there is also a strict operating rule that RBMKs must not be operated for any length of time below 20% full power. This is to avoid problems of thermal-hydraulic instability, the increased effect of the positive void coefficient and danger of an overall positive power coefficient. This rule and others were disregarded and some safety systems were disconnected in setting up the conditions for a turbine-generator test in April 1986 at Chernobyl-4. Forty seconds after the start of the test the operators initiated emergency shutdown. Two to three seconds later the reactor became prompt critical and disaster resulted. It is ironical that insertion of the control rods to effect emergency shutdown probably triggered the power pulse which led to the subsequent explosions. Since then modifications have been made to RBMKs to ensure that such an accident cannot happen again and by late 1986 most of the RBMKs were back in service at full power. UK authorities have studied the RBMK design, the USSR report of the accident and other analyses, and have expressed their firm belief that no such accident could happen with any of the UK reactors. (author).

40314 (TPR-NS–30-No.2) **Nuclear Safety: Technical progress review, April–June 1989.** Silver, E.G. (ed.). Oak Ridge National Lab., TN (USA). 1989. 165p. Sponsored by U.S. DOE Environment Health & Safety. Available from GPO; $8.50.

This review journal covers significant developments in the field of nuclear safety. Its scope includes the analysis and control of hazards associated with nuclear energy, operations involving fissionable materials, and the products of nuclear fission and their effects on the environment. Primary emphasis is on safety in reactor design, construction, and operation; however, the safety aspects of the entire fuel cycle, including fuel fabrication, spent-fuel processing, nuclear waste disposal, handling of radioisotopes, and environmental effects of these operations, are also treated.

40315 Sloshing of coolant in a seismically isolated reactor. Wu, T.S. (Argonne National Lab., Argonne, IL (US)); Guildys, J.; Seidensticker, R.W. vp. of Sloshing, vibration, and seismic response of fluid-structure systems. Ma, D.C.; Chen, S.S. American Society of Mechanical Engineers, New York, NY (1988). (CONF-8806217–: ASME pressure vessel and piping conference: vibration and seismic response of fluid-structure systems, Pittsburgh, PA (USA), 19-23 Jun 1988).

During a seismic event, the liquid coolant inside the reactor vessel has sloshing motion which is a low-frequency phenomenon. In a reactor system incorporated with seismic isolation, the isolation frequency usually is also very low. There is concern on the potential amplification of sloshing motion of the liquid coolant. This study investigates the effects of seismic isolation on the sloshing of liquid coolant inside the reactor vessel of a liquid metal cooled reactor. Based on a synthetic ground motion whose response spectra envelop those specified by the NRC Regulator Guide 1.60, it is found that the maximum sloshing wave height increases from 18 in. to almost 30 in. when the system is seismically isolated. Since higher sloshing wave may introduce severe impact forces and thermal shocks to the reactor closure and other components within the reactor vessel, adequate design considerations should be made either to suppress the wave height or to reduce the effects caused by high waves.

40316 Distribution of selected fission products that escaped the core during the accident at TMI-2. Cox, T.E. (EG and G Idaho Inc., Idaho Falls, ID (US)); Jacoby, J.K.; Voilleque, P.G.; Pelletier, C.A.; Daniel, J.A. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT (USA), 15-19 Jul 1985).

One consequence of the TMI-2 accident was the release of fission products from the fuel to the reactor coolant system and the subsequent transport of radioactivity to the reactor building, auxiliary building, and the environment. Post-accident measurements of radionuclide concentrations and fluid volumes have provided data on distributions in the plant. Measurement data of ^{3}H, ^{85}Kr, ^{133}Sr, and ^{90}Sr, ^{129}I and ^{131}I, and ^{137}Cs have been used to attempt to account for the total radionuclide inventories present at the time of the accident. Initial assessment showed that large fractions of all inventories were unaccounted for outside the fuel. Recent analytical results for samples of sludge, plenum scrapings, demineralizer resins, and fuel debris are used to develop more definitive accounts of these important inventories.

25 ENERGY STORAGE

Refer also to citation(s) 40175

40317 (DOE/CH/10093–52) **Energy storage and distribution program summary: Volume 2, Research summaries: Fiscal year 1988.** Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 167p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89000867/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This document summarizes the status of research and development projects supported by the Office of Energy Storage and Distribution (OESD). The document's purpose is to inform interested readers of our research progress in both the Electric Energy Systems and Energy Storage programs. Developing advanced electric system and energy storage technologies is contributing to our nation's energy goals. This document concentrates on the individual research projects and furnishes a more detailed version of the OESD program. A summary of each research project that was active in FY 1988 as a result of FY 1988 or prior-year funding is contained in this second volume. Each contract description contains base project information, the project's objectives, and the status of the research performed in FY 1988. A companion document, Energy Storage and Distribution Program Summary, Volume 1: Overview; Fiscal Year 1988, provides an overview of the mission, strategy, and content of the OESD program.

2506 Thermal

Refer also to citation(s) 40395

40318 (BFR-D–4-1989) **Design of aquifer thermal energy storage. A case study.** Johansson, S. Swedish Council for Building Research, Stockholm (Sweden). Dec 1988. 80p. Order Number DE89902423/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The study demonstrates the fundamental principles for calculating the temperature distribution in Aquifer Thermal Energy Storage System (ATES) and some calculation methods which can be used when designing ATES. For application of an ATES it is important to determine the groundwater flow in the aquifer. The groundwater flow is given by the geometry and boundaries of the aquifer, the hydraulic and thermal parameters of the aquifer, the groundwater recharge, pumping rates and temperature differences between the storage and the surrounding aquifer. The Swedish eskers, which are often suitable for ATES, are heterogeneous aquifers. An ATES north of Stockholm has been used as a test example for different calculation methods. The groundwater temperatures were well-known, due to extensive temperature measurements before and during the first storage phase. An advantage with approximative calculation methods is that they require only a few hydrogeological and thermal data for input. A simplified storage performance has to be assumed and also some thermal processes have to be ignored. One approximate method uses the thermal radius concept. The method is useful when designing an ATES project. Simulations in the horizontal plane do not take into account the density-dependent thermohydraulic phenomena. The calculated temperature can be

interpreted as the mean temperature over a vertical profile. The calculated temperature showed sufficiently good agreement with the temperature measurements from the actual ATES. (With 24 refs.).

40319 (EUR–10634) **Experiment on reciprocal salt pairs as latent heat storage systems.** Allenspacher, P.; Tamme, R. Commission of the European Communities, Luxembourg (Luxembourg). 1986. 78p. (In German). Available from NTIS (US Sales Only), PC A05/MF A01.

The suitability of the reciprocal salt pairs $NaNO_3/Ba(OH)_2$. $8H_2O$ (I) and $KNO_3/Ba(OH)_2$. $8H_2O$ (II) as low temperature latent heat storage materials has been studied in thermoanalytic static and dynamic experiments. The results of the temperatures and enthalpies of transition of these reciprocal salt pairs determined by other authors could be confirmed by thermo-analytic measurements. Static tests showed a decrease of heat storage capacity during the first cycles and that a constant heat storage capacity of 40-60% of the initial value was attained after 10-20 cycles. Cyclic tests in a dynamic 10 1 - heat storage system showed that the heat storage capacity of system I amounts to 210 kJ/kg in the temperature range from 57^0C to 37^0C and that of system II - 10% H_2O - amounts to 160 kJ/kg in the temperature range from 70^0C to 50^0C. The investigations have shown that reciprocal salt pairs can be used as heat storage materials in dynamic latent heat storage systems. A heat storage capacity of 80 kWh/m^3 should be realized with system I in the temperature range from 40^0C to 50^0C, where no satisfactory heat storage medium could be found up to now.

40320 (EUR–10928) **Evaluation of thermal storage for solar heating systems.** Marshall, R. Commission of the European Communities, Luxembourg (Luxembourg). 1987. 41p. Available from NTIS (US Sales Only), PC A03/MF A01.

This is an Executive Summary of the Final Report to the sponsors, entitled Evaluation of Thermal Storage for Solar Heating Systems. The study had a single objective: to develop a methodology which relates the design parameters which specify a combined solar heating system to long term system performance. The methodology, known as the SEU Design Method, consists of four steps: derivation of the fundamental equation, formation of the key non-dimensional groupings after introducing suitable reference parameters, establishment of the Design Method correlation constants, and validation of the method. Extensions to the Design Method are derived to include the effects of pipe losses, pump powers, and a heat exchanger embedded in the store. The equations so derived show the link between the SEU Design Method and the key storage parameter, its overall fluid to storage material heat transfer capacity. To account for the effects of stratification, a heuristic correction factor is derived using a simple analytic theory. The incorporation of these effects into the Design Method is shown to be straightforward. In the light of experience with the Cardiff storage device, it is concluded that the link between all the system parameters and system performance has been established. This conclusion needs to be tested for the other storage devices represented in the concerted action programme of the European Commission. The implication is that a method is now available for the examination of any solar system design incorporating storage for both thermal performance and economics with a minimum of computational effort.

40321 (ITL–8509, pp. 272-278) **Design of shallow horizontal pipe systems used as a heat source for heat pumps.** Phen, I. (Chalmers Univ. of Technology, Goeteborg, Sweden); Sundberg, J. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Earth Heat Pump Group, Chalmers University of Technology, Gothenburg, Sweden, has for several years been studying different systems of heat storage and heat extraction from the subsurface. One field of work has been to make dimensioning rules for heat extraction systems with shallow pipes in soil connected to a heat pump. A finite difference program, that includes freezing, has been used to calculate the brine temperature depending on different heat extraction rates. Not only the extraction rates affect the brine temperature but also climate, thermal properties of the soil, duration curve, and the distance between the pipes and between pipe and ground surface. 15 refs., 7 figs., 2 tabs.

40322 (ITL–8509, pp. 508-512) **Optimal management of heat storage for a heating and cooling plant. Equations and example of solution.** Vasselin, P.H. (Centre Univ., Orsay, France). Intertask Ltd., Ottawa, ON (Canada). 1985. (In French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The purpose of this study, was to demonstrate the economic advantages of warm and/or cold water thermal storage reservoirs allowing the recovery of heat removed during air conditioning and regularization of eletrical demand in large office buildings. For this purpose, a simplified program for calculating hourly thermal loads, was written based on DOE2 for thermal inertia problems of a building and on TRNSYS for solar gain. By developing the WAPITI simulation model, the optimum path for storage was calculated and both the ideal dimensions for the reservoirs and the expected saving were deduced. The economic calculation which can be obtained from this suggests a return of investment period of about four to eight years, under optimum conditions, in Montreal. The calculations done in WAPITI allow the designer to generate a command function enabling him to guide the facility along an optimum path for conditions which are partly unknown in advance.

2509 Batteries

40323 (DOE/ID–10235) **The development of flame prevention devices for nickel iron battery modules for electric vehicle use.** Johnson Controls, Inc., Milwaukee, WI (USA). Mar 1989. 57p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. Order Number DE89014341/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The effort described in this report consisted of an evaluation of several prototypical components of an electric vehicle battery pack and its safety devices, a critical review of the public technical and patent literature pertaining to combustible gas management, and an experimental evaluation of the best candidate approaches. Three approaches were selected for evaluation: explosion attenuation, hydraulic arresters (water traps), and mechanical module isolation. The major system constraints under which an approach would have to operate were defined as follows: a cost of less than $10 per module, compatibility with a common manifold for watering and venting, and stability in caustic and acid electrolytes. 27 refs., 17 figs., 6 tabs.

40324 (ECN–89-109) **Batteries for photovoltaic systems.** Ruiter, A.J. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1989. 76p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

An overview is given of the most important characteristics of different types of batteries. Next an overview is given of the availability and applicability of these batteries. Subsequently the lead battery, the nickel-cadmium battery, the sodium-sulfur battery and the zinc-bromine battery are discussed. The appendices contain product information on the two last mentioned battery types. 1 fig., 1 tab., 3 apps.

40325 (EUR–10959) **Anglo-Danish advanced battery project.** Hooper, A.; North, J.M.; Taylor, R.I.; Daniels, L.C.; Horsley, G.; Oliver, M.R.; Hawkins, A.J. Commission of the European Communities, Luxembourg (Luxembourg). 1987. 27p. Available from NTIS (US Sales Only), PC A03/MF A01.

A number of aspects relevant to the scale-up of all-solid-state, polymeric electrolyte, rechargeable lithium batteries have been studied. A nominal 1.7 Ah cell has been fabricated and cycled at 120°C. At the 17 hour discharge rate, the initial cathode utilization, between voltage limits of 2.0 and 2.9 volts, is ~ 70% theoretical, falling to 20% after 50 cycles. The controlled production of the cathode material, V_6O_{13}, has been studied in detail. 1/2 Kg batches of pure material have been produced using a technique which may be utilized on an industrial scale. Thermal modelling studies have provided useful information regarding the potential thermal behaviour of cells. Small internally generated temperature rises are predicted for cells operating at rates consistent with vehicle traction applications. The effect of cell size and the role of inter-cell connectors have been evaluated in specific cases. Work to date indicates the importance of the particular duty or driving cycle in determining the effective thermal behaviour of cells and batteries.

40326 (NEI-DK–178) **Solid state sodium cells.** Skaarup, S.; West, K. (eds.). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. 152p. (In Danish, English). Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

The report describes the results from the project: "Secondary Sodium Cells with Intercalation Electrodes" which was financed by the Danish Department of Energy. The work was carried out by the Solid State Electrochemistry Group at the Technical University of Denmark which is formed by collaborators from the Institute of Physical Chemistry and Physics Laboratory III. The use of sodium has several advantages in theory compared to lithium systems: Sodium is much more abundant and lower priced than lithium, it may be easier to find solid electrolytes of sufficiently high conductivity, sodium forms no alloy with aluminium thereby making it possible to use this metal for current collectors instead of the costlier and heavier nickel. The softness of sodium metal may make it easier to achieve and maintain contact to other components in the battery during repeated cycling. This might be of importance for room temperature operation especially. Results from the project have primarily been published in the form of articles in international scientific journals and as contributions to monographs. Copies of these articles form the backbone of the report together with a short commentary to each article. Also included in the report are some general observations, as well as results that are unsuited for publication (e.g. unsuccessful experiments) but which may still contain relevant information for other experimental workers. Lastly, the report includes results on several intercalation compounds that will be published at a later stage as well as some details about the experimental equipment. The report is divided into three main sections, Intercalation Cathode Materials, Polymer Electrolytes and Battery Cycling Equipment. (AB).

29 ENERGY PLANNING AND POLICY

40327 (CONF-8904249–) **US-Japan energy policy consultations: Final narrative report.** Atlantic Council of the United States, Washington, DC (USA). 15 May 1989. 150p. Sponsored by U.S. DOE Management & Administration. DOE Contract FG01-88IE10688. From U.S.-Japan Energy Policy Consultations meeting; Mt. Fuji (Japan); 9-11 Apr 1989. Order Number DE89013969/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report is a group of papers given at the US-Japan Energy Policy Consultations. These papers on energy policy include topics such as: the world energy situation; global warming; the oil, natural gas, and coal situations in the US and Japan; nuclear power; and other energy policy issues. (JEF)

40328 (CRIE–T-87098) **Protection and control method by using on-line data on distribution system (Part 3). Development of high-speed fault detection and restoration system.** Yukihira, Kenji; Inoue, Yukio; Miyauchi, Motomitsu. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 21p. (In Japanese). Order Number DE89760380/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

The more advanced distribution automation system, which follows the ones which are being developed in the electric power companies, has been researched. So far, a concept of the whole system and the functions, which the system should possess, have been suggested. Now, under the basic manipulation logic which has been proposed, the system with the multipurpose operational functions was developed, for example, monitoring of the power systems and control of the switches at ordinary times, detection of the fault section by emergency interrupt in an accident, and the restoration. A sharp reduction of the stoppage area of electric power is able to be performed by the system, through the controls of the breakers and the switches for the grounding fault or the short circuit failure by detection of the abnormality. Through various tests, confirmations of both quick response for an alteration of the distribution system and correct detection of the fault section, and clarification of the time limit coordination condition, were carried out. It was varified that the system based on the proposed control theory is operated correctly. 13 figures.

40329 (ETDE-mf–9794853) **Short report about the state of the energy discussion 1984/85. Summarized papers of a seminar during the autumn and winter term 1984/85 at the Universitaet der Bundeswehr Muenchen on the subject 'Economic and legal problems of energy supply'.** Ederer, F.; Schulz, W.; Steinkamm, A. (eds.). Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Volkswirtschaftslehre. 1987. 72p. (In German). Order Number DE89794853/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

The short versions of the lectures held at this seminar are grouped under the following headings. 1. pipeline and cable transported energies (electricity and gas industry), 2. legal questions of energy supply (energy laws, licensing, procedural law); economic aspects of energy supply (energy prognoses, -prices, -substitution), 4. conservation of energy and alternative energy technologies. (UA).

40330 (SIB-SB–15) **Energy market and energy policy - studies and opinions 1983-88.** Wickman, K. Statens Inst. foer Byggnadsforskning, Gaevle (Sweden). Sep 1988. 210p. (In Swedish). Order Number DE89902473/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

This collection of energy market studies contains material and conclusions as to energy market adjustments and energy policy effects in Sweden. One of the main conclusions is that the market arguments (i.e. prices and incomes) seem to work efficiently both in the short and the long run. The political management of the complex energy markets seems, because of this, to be ambiguos. Special projects analysed in detail are loans and subsidies to home owners to conserve energy, the policy to dismantle the nuclear power system until 2010 (which seems to be misguided) and the taxation of coal and oil. (author) (With 62 refs.).

40331 (STEV-VIND–89-9) **Benefit assessment of wind power in hydro-thermal power systems.** Soeder, L. Statens Energiverk, Stockholm (Sweden). 1989. 160p. Order Number DE89902469/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

This report contains the result of a study concerning wind power integration into hydro-thermal power systems. Methods usable to estimate the energy and capacity credits of wind power are developed. The integration of wind power into power systems operation planning including influence on reserve margins is also studied. Wind power has a random character of primary energy. Wind speed variations at different sites are interdependent while forced outages of different wind power units can be treated as independent events. The method of estimating the energy and capacity credits of wind power includes these facts and is based on the theory of probabilistic production costing. With a large-scale introduction of wind power the system operation including keeping of spinning reserves will be influenced since extra uncertainties are introduced. To study this a more detailed analyze of system operation is required. Parameters such as wind speed forecast uncertainties, system load forecast uncertainties, ramp rates of thermal units, spinning reserves and economic optimal scheduling have to be considered. A detailed schedule of each wind, hydro or thermal unit for each hour in the

planning period is determined. The requirements of instantaneous, fast and slow reserves, depending on possible forced outages of thermal units and uncertain load and wind speed forecasts etc., are then calculated together with the available capacities of the corresponding reserve type. The result includes an estimation of whether there are deficit or excess of instantaneous, fast or slow reserves, during the hours of the planning period. (author) (With 124 refs.).

2901 Energy Analysis and Modeling

Refer also to citation(s) 40334, 40374, 40862

40332 (ESC-WR–89-10) **The impact of energy import and export on the Dutch balance of payments, 1960-2010.** Kossen, A. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Jun 1989. 46p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Energy import and export data for the period 1960-1987 are presented and analyzed. Also data for the years 2000 and 2010 are discussed. The structure of the Dutch balance of payments is explained. The connection between the balance of goods and the energy balance in the period 1960-1987 is discussed. Then the structure of the energy balance is dealt with. Next the possible energy balances for the years 2000 and 2010 are considered. Finally conclusions are presented. It is concluded that, apart from some exceptions, a reasonable connection exists between the balance of goods and the energy balance. 9 figs., 11 refs., 8 tabs.

2902 Economics and Sociology

Refer also to citation(s) 40342, 40352, 40353, 40355, 40356, 40358, 40436

40333 (CONF-8810273–, pp. 7, Paper 3) **Comments on the Middle East situation.** King, W.C. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Mr. King points to 4 significant developments in the Middle East over the past year: (1) the cease-fire in the Iran-Iraq war; (2) Russian withdrawal from Afghanistan; (3) Turkey's application for membership in the European Community; and (4) the Israeli/Palestinian conflict, particularly Palestinian street demonstrations in the West Bank and Gaza. He discusses the implications, feeling that: (a) truces in the Iran-Iraq war and in Afghanistan strengthen the positions of moderates; (b) the Turkish initiative for entry into the EC will pressure OECD nations to assist economic growth in the Middle East; and (c) the intensifying Palestinian unrest will pressure Israel to come to grips with the problem. He notes that many complex factors are involved in a Middle East peace initiative, but makes recommendations that should be considered since this peace is so vital to the entire global economy.

40334 (DOE/EIA–0184/2) **The feasibility of financing domestic energy development during 1978–1984: Analysis report.** Kanhouwa, S.P. USDOE Energy Information Administration, Washington, DC (USA). Assistant Administrator for Applied Analysis. May 1979. 116p. Sponsored by U.S. DOE Management & Administration. (AR/EI–79-26). Order Number DE89014993/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

This report is an elaboration and an extension of the Section on "Finance" presented in Chapter 3 of the 1977 Annual Report to the Congress (ARC) by the Energy Information Administration. It introduces the satisfactory financing of energy as yet another factor likely to significantly affect the sensitivity of alternative energy-supply projections shown in the ARC. Accordingly, its primary purpose is to assess whether the growth of private investment demand in energy – as implied by the projections – can be adequately met in the future. 20 tabs.

40335 (LA-UR–89-2425) **Energy security in a competitive world.** Stevenson, M.G. Los Alamos National Lab., NM (USA). 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8907103–2: Technology-based confidence building: energy and environment, Santa Fe, NM (USA), 9-14 Jul 1989). Order Number DE89015253/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses global energy security policy direction including: energy sources; environmental effects; new technology; marketing, pricing, and sales of energy fuels; and cooperation models. (JEF)

40336 (STEV–1988-R14) **Evaluation of the Swedish subsidy of oil prospecting.** Appelgren, L. Statens Energiverk, Stockholm (Sweden). Sep 1988. 59p. (In Swedish). Order Number DE89902438/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The consequences of the support were evaluated. The support did not yield the effects expected, mainly owing to the following factors: * unrealistic prognosis, * high real cost increase, * less allocation of resources than expected, * decreasing level of activity after 1984, * higher cost of prospecting in Sweden, * random factors, mainly when building new fields is considered. A greater flexibility in utilization of the subsidies to Swedish Petroleum Exploration Ltd. would be desirable. It would for example be possible to partly finance acquisition of field or deposit shares by menas of subsidies. If remaining funds will be used for further allowances to private companies a revision of the rules of repayment is suggested.

40337 (UCRL–101401) **Decline in energy use in the seventies and early eighties.** Borg, I.Y. Lawrence Livermore National Lab., CA (USA). Jul 1989. 15p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-48. (CONF-8907103–3: Technology-based confidence building: energy and environment, Santa Fe, NM (USA), 9-14 Jul 1989). Order Number DE89016639/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The key to the decline in US energy consumption in the seventies and eighties lies in the US industrial sector. Changes in its output – both in quantity and product mix – led to large decreases in energy use which have persisted to the end of the present decade. Energy saving through improvements in efficiency in the industrial sector, over and above those associated with normal capital stock turnover, appear to be much smaller than those associated with change in the output of the sector. Some of these changes were evident before the rise in the price of fuels in the seventies, but most were set in motion by the price increases. Energy-intensive industries have continued to decline and import reliance on their products has increased. This is tantamount to importing energy in the form of products that has no expression in tallies of annual US energy use. By contrast, conservation in other end-use sectors has shown a strong price elasticity. 12 refs., 8 figs.

2903 Environment, Health, and Safety

Refer also to citation(s) 40344, 40877, 40880

2904 Natural Resources

Refer also to citation(s) 40019, 40025, 40043, 40068, 40075, 40362

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 40317, 40435, 40508

40338 (CONF-890845–1) **Promoting the commercialization of energy innovations: An evaluation of the Energy-Related Inventions Program.** Brown, M.A. Oak Ridge National Lab., TN (USA). Jun 1989. 12p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 4. international energy conservation program evaluation conference; Chicago, IL (USA); 21-25 Aug 1989. Order Number DE89014073/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents the results of an evaluation of the US Department of Energy's Energy-Related Inventions Program (ERIP). ERIP provides small grants and technical assistance to small businesses and independent inventors attempting to develop and commercialize

new energy technologies. The primary purpose of this evaluation is to assess the effectiveness of ERIP in moving these technologies from the laboratory bench to the marketplace. A secondary purpose is to better understand the commercialization process so that the program can better target its services. The research design involves analysis of data on 250 ERIP participants and a comparison of findings with previous research. 9 refs., 2 figs., 2 tabs.

40339 (CONF-890845–2) **Evaluating energy-efficiency programs: A personal view of progress and potential.** Hirst, E. Oak Ridge National Lab., TN (USA). Jun 1989. 19p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 4. international energy conservation program evaluation conference; Chicago, IL (USA); 21-25 Aug 1989. Order Number DE89015045/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Evaluation of energy-efficiency programs has come of age. Substantial progress has been made during the past decade in the development and application of improved methods to measure the cost and performance of such programs. These developments include: use of quasi-experimental designs; use of fuel-consumption data to measure energy savings; weather-normalization of fuel-consumption data; consideration of nonresponse bias, self-selection, take-back, and free riders; evaluation of long-term program effects; integration of outcomes and process evaluations; and use of data from a variety of sources and for purposes beyond evaluation. Program evaluators will face new challenges during the 1990s, largely because the role of energy-efficiency programs will expand greatly. These challenges include: integration of evaluation results with forecasts of energy use; conversion of evaluation results into a form useful for program planning; and development of standardized methods to conduct evaluations and to report evaluation results. 42 refs., 2 figs., 4 tabs.

40340 (DNE–9015033-Pt.2B) **National register of research projects, 1986/87: Part 2B: Natural sciences: Physical, engineering and related sciences (New projects).** Department of National Education, Pretoria (South Africa). Aug 1988. 183p. Order Number DE89015033/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI.

This Register is intended to serve as a source of information on research which is being conducted in all fields (both natural and human sciences) in the Republic of South Africa. New and current research projects that were commenced or modified during 1986 and 1987, on which information was received by the compilers until January 1988, are included, with the exception of confidential projects. Project titles and keywords are presented in the language as supplied, and the classifications are based on those provided by the primary sources.

40341 (DNE–9015034-Pt.1) **National Register of Research Projects, 1986/87: Part 1, Natural sciences: Biological, medical and related sciences.** Department of National Education, Pretoria (South Africa). Aug 1988. 227p. (In Afrikaans, English). Order Number DE89015034/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI.

This Register is intended to serve as a source of information on research which is being conducted in all fields (both natural and human sciences) in the Republic of South Africa. New and current research projects that were commenced or modified during 1986 and 1987, on which information was received by the compilers until January 1988, are included, with the exception of confidential projects. Project titles and keywords are presented in the language as supplied, and the classifications are based on those provided by the primary sources.

40342 (DNE–9015035-Pt.4) **National register of research projects, 1986/87: Part 4: Human sciences: Economic, political, language, art and other sciences.** Department of National Education, Pretoria (South Africa). Aug 1988. 129p. (In English, Afrikaans). Order Number DE89015035/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI.

This Register is intended to serve as a source of information on research which is being conducted in all fields (both natural and human sciences) in the Republic of South Africa. New and current research projects that were commenced or modified during 1986 and 1987, on which information was received by the compilers until January 1988, are included, with the exception of confidential projects. Project titles and keywords are presented in the language as supplied, and the classifications are based on those provided by the primary sources.

40343 (EPRI-NP–6448) **EPRI operations and maintenance source book: 1987-1989 update: Strategic program element 24.** Electric Power Research Inst., Palo Alto, CA (USA). c Jun 1989. 425p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50940, Palo Alto, CA 94303.

This Source Book is composed of four parts: Summary Overview; Current Research; Reports; and Results Documents. The General Overview places the Operations and Maintenance Program in perspective relative to the Institute, the Nuclear Power Division and the Engineering and Operations Department. This overview is particularly useful to those who are not familiar with the EPRI organization. This document is a single reference to the results of all of the research conducted in the Operations and Maintenance Program of the EPRI Nuclear Power Division through 1988, and includes summaries of the contracts active in 1989. It is a compilation of over two hundred and fifty research reports and products generated since 1973. The intent of this Source Book is to provide a succinct summary of each report and product in a well cross-referenced and tabulated format. It is an update of the previous publication (NP-4986-SR), but the results are cited in a new, keyword-based format. Instructions for report acquisition are provided, as are the telephone numbers for EPRI staff contacts. Although this research is conducted under the auspices of the Nuclear Power Division, many results have applications beyond nuclear plants. Those listed under the Fossil Fuel Power Plants keyword are directed towards generic problems with common or balance of plant equipment. Whenever possible, utility contacts already using a result are included.

2906 Nuclear Energy

Refer also to citation(s) 40224, 40225, 40226, 40252, 40361, 40362, 40366

40344 (CONF-890810–1) **CO_2 and the world energy system: The role of nuclear power.** Fulkerson, W.; Jones, J.E. Jr. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. From Seminar on small and medium sized reactors, design, safety and marketing potential; San Diego, CA (USA); 21-23 Aug 1989. Order Number DE89013014/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The greenhouse effect, and other transnational and global environment, health and safety issues, require energy system planning on an international scale. Consideration of equity between nations and regions, particularly between the industrialized and developing countries, is an essential ingredient. For the immediate future, the next several decades at least, fossil fuels will remain the predominant energy sources. More efficient use of energy seems to be the only feasible strategy for the near to mid-term to provide growing energy services for the world economy while moderating the increasing demand for fossil fuels. In the longer term, nonfossil sources are essential for a sustainable world energy system, and nuclear power can play an important, if not dominant, role. The challenge is to design and implement a safe and economic nuclear power world enterprise which is socially acceptable and is complimentary to other nonfossil sources. The elements of such an enterprise seem clear and include: much safer reactors, preferably passively safe, which can be developed at various scales; development of economic resource extension technologies; effective and permanent waste management strategies; and strengthened safeguards against diversion of nuclear materials to weapons. All of these elements can best be developed as cooperative international efforts. In the process, institutional improvements are equally as important as technological improvements; the two must proceed hand-in-hand. 14 refs., 4 figs., 1 tab.

40345 (CONF-8810273–, pp. 9, Paper 8) **Nuclear power and related issues: the US outlook.** Burstein, S. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan

energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

The author notes there are now 108 nuclear units licensed to operate in the US and another 18 under construction or completed but not licensed; nuclear power provided 19.5% of US total electrical energy as of May 1988. One of the most disturbing items is the increase in operating and maintenance costs of US nuclear plants which, in some cases, exceed costs of coal-fired plants. US leadership in nuclear power has lost much momentum due primarily to institutional rather than technological problems. There are some indications, however, that the anti-nuclear fever of the past is receding, namely: (1) President Reagan recently endorsing the need for nuclear power by signing legislation extending Price-Anderson nuclear insurance protection; (2) a more favorable regulatory climate; (3) some progress on the nuclear waste problem; (4) more supportive public acceptance; (5) decommissioning activities; (6) increased attention of plant aging and 40-yr. license requirement; (7) radon concerns, ironically, because of conservation practices; and (8) substantial progress in advanced reactor technology.

40346 (CONF-8810273–, pp. 9, Paper 9) **Outlook for nuclear energy in Japan.** Akiyama, Y. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

The author first summarizes the historical significance of nuclear power, pointing out that present plants now have an aggregate capacity of over 300 million kW; this generation capacity is equivalent to some 7.4 million barrels/day of petroleum, or 40% of OPEC production. Next, he discusses the significance of the TMI and Chernobyl accidents and lessons learned from them in the context of present global viewpoints and increasing energy demands, as well as environmental concerns with fossil use. He observes that Japan has positioned nuclear power as a key energy source in optimum energy-supply structure. They are determined to actively promote advanced light-water reactors and establish an independent closed nuclear fuel cycle, feeling LWR technology is mature, cost-competitive, and safe. Top priority will be given to establishment of public acceptance.

40347 (INIS-mf–11993) **Physics as the centerpart.** Wirtz, K. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1988. 265p. (In German). Order Number DE89795119/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

The author gives a review of his professional career and life, which at the same time is a survey of the development of nuclear engineering in the Federal Republic of Germany and in other countries. The survey extends up to the current situation and is concluded by an outlook into the future. (DG).

40348 (LUSG-WP–501) **Communicating risk: news media reportage of a significant nuclear contamination incident in the UK.** Walker, G.P.; Macgill, S.M. Leeds Univ. (UK). School of Geography. Feb 1988. 59p. Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The way the mass media reported a controversial discharge incident at British Nuclear Fuel's reprocessing plant at Sellafield in Cumbria in November 1983 is discussed. Apart from the Windscale fire in 1957 this was the most serious radiation incident at any nuclear installation in the United Kingdom. The aim of the study was to use that incident to develop a more complete understanding of the way information about risk is communicated through the news media. Two issues, in particular, are assessed. First, the accuracy of the reports of events and how factual, technical or scientific aspects of risk are portrayed through the news media. Secondly, risk evaluation is studied: what value judgements are made, what sentiments of alarm, danger and hazard are presented. (author).

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 40354, 40366

40349 (CONF-8810273–, pp. 14, Paper 4) **US Energy '88: countdown to the next crisis.** Bowen, W.J. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Mr. Bowen surveys the primary staples of US energy supplies - oil, gas, coal, nuclear, electricity, and conservation - and finds us drifting toward a serious energy crisis, particularly since the political leadership has not addressed (and is now reluctant to address) the issues. Specifically, (1) oil demand is rising, while domestic production is declining; (2) the transportation sector is consuming 20% more oil than in 1974; and (3) electricity, which helped reduce dependence on imported oil, now faces its own uncertainties. Despite the fact that natural gas supplies are favorable (even at increased demand levels), and along with coal, nuclear power, and conservation provide us with a secure and balanced mix, Mr. Bowen sees the US on a countdown to a new and probably prolonged energy crisis, primarily because of our over-reliance on oil imports. He makes 8 specific recommendations that can help alleviate the situation.

40350 (CONF-8810273–, pp. 3, Paper 15) **New energy development.** Sueda, M. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

The author feels that new energy technology development for Japan can be categorized as follows: (1) technology that enables use and consumption of energy sources that otherwise are not usable by fluidizing them or making them pollution-free (or less polluting) without substantially changing the existing energy distribution system: e.g., liquefaction and gasification of coal, and methane production from biomass, etc.; (2) technology that enables utilization of indigenous energy sources with low energy density or with difficulty of economically viable commercialization, e.g., solar, geothermal, wind, etc.; (3) technology that efficiently converts primary energy sources to energy forms amenable to effective final consumption, e.g., fuel oils, sterling engines, superconductivity, etc.; and (4) technology that efficiently stores electricity and heat, and adjusts time lag between supply and demand, thus enabling efficient operation of energy-conversion facilities and improving availability factor, e.g., heat pumps, new types of cells, etc.

40351 (CRIE–Y-88006) **Multi-sectoral econometric modelling (Part 1). Basic structure and data base.** Hattori, Tsuneaki; Sakurai, Norihisa. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Sep 1988. 27p. (In Japanese). Order Number DE89760362/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

This study incorporates the worldwide energy demand, Japanese economic and industrial structures, electric power demand, local economy, ect. into this system as a part of developing medium term economical forecasting system to consistently analyze the above mentioned: and aims development of multi-sectoral model to analyze our macro economy, that is, industrial structure. This report describes the basic structure and data base. Imbalance dynamic model with new SNA was selected to develop the model. New method to apply time-series input-output tables to be developed newly to the industrial structure, to apply new SNA to macro economy and to link both consistently was devised to realize the basic concept and to develop the model. Multi-sectional econometric model can be developed by formulating the theoretical model on the basis of basic concept and by developing data such as time-series input-output tables. 24 references, 4 figures, 1 table.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 40345, 40346, 40349, 40350, 40367, 40880

40352 (CONF-8810273–, pp. 6, Paper 1) **Impact of pertinent international issues on US-Japan energy interests and relations.** Silas, C.J. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy*

policy consultations. Order Number DE89003853/JAW. Available from NTIS, PC A 07.

A continuation of the trend on the part of governments and companies from consuming nations (like Japan) to make substantial investments in the upstream activities of US energy companies is anticipated. And continuation of downstream investments by producing governments (like Saudi Arabia) is expected. Nevertheless, from the political standpoint, it will be important to avoid the perception in the United States that governments and companies investing in US assets are from areas of the world where US investment is restricted or excluded. The concept of reciprocity is important in the United States and needs to be reinforced wherever possible. The efforts of The Atlantic Council and others will be important to insure that political rhetoric does not get out of hand or become a useful tool for those who have an interest in widening the divisions between the United States and Japan.

40353 (CONF-8810273–, pp. 10, Paper 2) **Age of Asia and US-Japan cooperation.** Okumura, A. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

The author first points to the high economic growth rate in Asia - 4.2% in Japan, 11.6% by Asian NIEs, 4.6% ASEAN, and 9.3% by China compared to 2.9% in the US and 2.4% in the European Communities. He notes that energy demand is expected to grow at 5 to 7% in Asia during the coming 10 years. He specifically addresses the oil-supply problem in Japan (99.6% imports) and the US (40% imports) and the dependence on the Middle East - 68% and 22%, respectively. For US-Japan cooperation, he suggests the following: (1) hold seminars/workshops for furthering know-how in energy data collection and analysis; (2) promote efficient use of energy by providing technology and know-how; and (3) increase the share of non-oil energy and alternative energy to reduce dependence on fossil sources.

40354 (CONF-8810273–, pp. 6, Paper 14) **New energy development.** Davis, W.K. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Mr. Davis, in reviewing US energy activities over the past 15 years, suggests we may have been on the wrong track; i.e., perhaps over-reacting to the oil crises of 1973 and 1978 by setting out for energy independence, energy security, conservation, etc., regardless of the costs. Also, we instigated very ambitious technology development programs - synthetic fuels, geothermal, solar, wind, shale oil, etc. - justified on the basis that crude oil was going to cost 50 to $100/bbl. Mr. Davis points out that even today the free market price of crude oil (if there were a free market) would likely be around $10/bbl - and might be as much as $15/bbl by 2000 AD in today's dollars. His main theme here, though, is that while technology can make substantial contributions, if pursued with the correct goals the broader aspects of energy supply and price are geopolitical, not technical. He faults national leadership - primarily in the US, but other countries as well, for not considering the political aspects but apparently feeling the miracles of modern science will solve the problem.

40355 (CONF-8810273–, pp. 3, Paper 16) **Summary–US.** Davis, W.K. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Mr. Davis summarizes the presentations at the meeting according to: (1) demand side; (2) supply side; (3) environmental concerns; (4) nuclear energy; (5) public opinion; and (6) political aspects of energy. He found the presentations generally interesting and constructive, particularly in the stimulating thinking of US participants. He notes the US side would like to see more emphasis on discussions, particularly informal comments and discussions. He suggests two subjects (not discussed) that might be considered for future meetings: (a) the impact of the US-Canada Free Trade Agreement; and (b) the impact of removal of financial and trade barriers in the Common Market by 1992. He says the US participants feel these meetings are very worthwhile, and deeply appreciate the contributions from the Japanese side.

40356 (CONF-8810273–, pp. 4, Paper 17) **Summation of the conference in Hawaii as viewed from the Japanese side.** Ikuta, T. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Mr. Ikuta feels substantive views were exchanged, making the meeting quite successful. As far as energy supply and demand is concerned, he sees oil playing the leading role - with the supply and demand of oil and its price having a great effect on development of other sources from a long-term perspective. He thinks new energy sources, especially renewable energy sources for countries with large populations, e.g., China and India, are vital for the long term. Further, it is more important to continue steady, well-planned efforts than to press for immediate success.

40357 (DOE/EIA–0264) **A review of requirements for natural gas data.** USDOE Energy Information Administration, Washington, DC (USA). Assistant Administrator for Energy Information Validation; Oak Ridge Associated Universities, Inc., TN (USA). Dec 1980. 240p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-76OR00033. Order Number DE89014995/JAW. Available from NTIS, PC A11/MF A01 - GPO - OSTI; GPO Dep.

The Energy Information Administration (EIA) of the Department of Energy (DOE) has primary responsibility for collecting all energy data required by the federal government. The only exceptions are those energy data collected by non-DOE federal agencies in existence before the Department of Energy was created – such as the Department of Transportation. Because of the importance of these data for use in formulating energy policy, the EIA's Office of Energy Information Validation (OEIV) periodically reviews the quality and kinds of data being collected concerning each fuel to ensure that the federal government's needs for energy data are being met while keeping the burden on the public to a minimum. The purpose of this study is to provide a broad, integrated review of DOE's requirements for natural gas data and to compare these requirements with the existing collecting systems. Using the knowledge gained from this review, the study also contains a recommended framework for conducting future validation studies on specific DOE natural gas data systems. 25 refs., 3 figs., 13 tabs.

2940 Fossil Fuels

Refer also to citation(s) 39882, 39893, 39899, 40357, 40866

40358 (CONF-8810273–, pp. 10, Paper 10) **Oil, coal, and related issues.** King, W.C. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Mr. King notes that the major oil issue is expected price levels, and he starts by examining possible production levels in 1995. If all OPEC and Middle East producers, except Saudi Arabia, increase production to their highest historic levels, 1979 - and the Saudis increase proportionately over present levels, production would be 28.4 mb/d. World consumption would be 65.4 mb/d, an annual growth rate of 2% over the 8-yr. period. He thinks price increases, however, are unlikely because: (1) the Saudis would still have 3-4 mb/d unused capacity; (2) 2% growth rate in consumption would be relatively high, causing consuming nations to take measures, e.g., conservation to reduce it; and (3) in 1987, Iraq, Iran and Abu Dhabi announced aggregate additions to reserves of 132 billion bbls., a 22% increase in total world reserve. When combined with reasonable estimates of discovery, present proven reserves would sustain 65 mb/d into middle of the next century. On coal, Mr. King notes world's proven reserves are several times larger than oil, and at present consumption rates could last 205 yrs. He feels the present conception of coal's environmental problems may be somewhat

overdrawn, and does not believe that deferral of coal-conversion technologies presents a practical problem.

40359 (CONF-8810273–, pp. 8, Paper 11) **Oil and related issues.** Saikawa, K. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

For Japan, a country with virtually no petroleum resources, the development of independent sources of oil by Japanese industry and government is a vital part of national oil strategy. Nippon Oil and many other oil companies are actively involved in such development projects, which the government is supporting as well. Oil-related expenditures from the national budget amount to 387 billion year; of this, 95 billion year is targeted at oil development. However, results obtained thus far have been less than satisfactory. Last year, only 300,000 b/d of the oil imported to Japan were independently developed by Japanese companies - about 10% of total crude-oil imports. Furthermore, because of recent low crude-oil prices and uncertainty about what lies ahead, the independent development of sources of oil is becoming more and more difficult. In addition to development activities, the purchase of oil fields overseas is also being studied. The Japanese oil industry hopes for stable crude-oil prices. Even though they will continue their development projects, maintenance of an appropriate price level will remain essential. 5 tables.

40360 (CONF-8810273–, pp. 4, Paper 12) **Status of US coal.** Holmes, C.D. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Coal production in the United States set records for the third consecutive year in 1988 when 945 million short tons will be mined. Most of this, 750 million tons, will be used by utilities throughout the US; coal fuels 57% of the electricity generated. Far less is used for metallurgical coal or for industry. Growth in the coal industry is expected to average about 2% per year for the next 11 years, and present consumption patterns should continue thru the rest of this century. Issues facing the US coal industry are not production-related. Issues that will shape the future of the coal industry are environmental issues - the problems of SO_2 and NO_x emissions, the new issue of CO_2 emissions, and global warming or the greenhouse effect. In addition to these issues, the author also discusses briefly coal in the energy-fuel mix and trade issues.

40361 (DOE/EIA–0181(79)) **Energy data report: Annual energy balance, 1979.** USDOE Energy Information Administration, Washington, DC (USA). Jun 1980. 16p. Sponsored by U.S. DOE Management & Administration. Order Number DE89014977/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper contains statistical data on energy source consumption to include: nuclear energy; coal; petroleum; natural gas; hydroelectric; and other nonfossil sources. (JEF)

40362 (DOE/EIA–0181(81)) **Energy data report: Annual energy summary, 1981.** USDOE Energy Information Administration, Washington, DC (USA). 17 May 1982. 8p. Sponsored by U.S. DOE Management & Administration. Order Number DE89014976/JAW. Available from NTIS, PC A02/MF A01 - GPO - OSTI; GPO Dep.

Data in this summary have been extracted from the Energy Information Administration's publication, Annual Report to Congress, 1981, Volume 2, May 1982. This summary is provided to keep the public informed with respect to historical and current energy production, consumption, and stocks. 17 tabs.

40363 (DOE/EIA–0414) **The weekly petroleum status report: Technical background.** Burns, E.M. USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. Aug 1983. 94p. Sponsored by U.S. DOE Management & Administration. Order Number DE89015001/JAW. Available from NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.

The Weekly Petroleum Status Report (WPSR) was first published in April 1979 as part of the Department of Energy's response to the instability in petroleum supply caused by the cutoff in oil imports from Iran. The WPSR was designed to provide information on petroleum stocks, imports and refinery operations in a more timely manner than the Energy Information Administration (EIA) monthly petroleum publications. As currently published, the WPSR contains four main categories of petroleum information: historical figures from the EIA's monthly petroleum surveys; current week estimates based on data from the EIA's weekly petroleum surveys; current week estimates based on data from the EIA's monthly petroleum surveys, for items not surveyed weekly; and related items, such as spot market product prices and heating degree days, which are taken from other sources. 10 refs., 4 figs., 5 tabs.

40364 (DOE/EIA–0520(89/07)) **International petroleum statistics report, July 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 27 Jul 1989. 42p. Sponsored by U.S. DOE Management & Administration. Order Number DE89015736/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and on oil consumption and stocks in the Organization for Economic Co-operation and Development (OECD). Section 1 contains annual data beginning in 1973, and monthly data for the most recent two years. Section 2 presents an oil supply/consumption balance for the market economies (i.e., non-communist countries). This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data beginning in 1982, and quarterly data for the most recent two years.

40365 (DOE/FE/60603–T4) **Reserve growth and future US oil supplies: Final report.** Lewin and Associates, Inc., Washington, DC (USA). 30 Jun 1986. 31p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC01-85FE60603. Order Number DE89015963/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Additional crude oil from reserve growth – the more intensive development of already discovered fields – represents a major potential source for future oil supplies. In spite of the massive size of its potential, estimated at 35 billion for Texas alone, this source of future US oil supplies has remained largely undefined. The first state-wide geologically based estimate of reserve growth has been by the Bureau of Economic Geology (BEG), University of Texas at Austin. The BEG study used a database of 450 large Texas reservoirs, grouped into 48 geologically similar plays, and a geological model of reservoir heterogeneity for estimating additional "target oil" from strategic infill drilling and development. The purpose of our task was to review the BEG findings, to establish the nature and technical basis for their methodology, and to determine whether this approach could be applicable and contribute to the national assessment of the replacement cost of domestic crude oil reserves being sponsored by the US Department of Energy/Fossil Energy. 5 figs., 9 tabs.

40366 (ESC-WR–89-09) **Interactive price program. Description of a spreadsheet program in Symphony 2.0.** Koenders, N.J. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. May 1989. 44p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The title program can calculate for a few future years energy prices of oil, oil products, coal and natural gas. Also starting points and results of uranium prices can be given. Important input data are the oil price in US dollars, as well as the coal price in US dollars and the exchange rate of the US dollar. First a general user instruction is given in which the software is discussed: start of the program, functions, and the reversive spreadsheet. Then the modules are dealt with. In particular the price structure of the energy sources is explained. Next printing of the results and filing the program and the data are discussed. In the appendix the basic version of the interactive price program (IPP) is presented in which historical data for the years 1985-1988 and in some cases for 1989 can be found. 11 figs., 6 refs., 1 app.

2960 Electric Power

Refer also to citation(s) 40175, 40361

40367 (CONF-8810273–, pp. 8, Paper 6) **US electricity outlook: ensuring the future of electricity's role in a changing environment.** Kuhn, T.R. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

Mr. Kuhn notes that the US electric utility industry is pursuing aggressively policy reforms to meet present and future needs in a shifting economic and regulatory structure and demographic outlook. Among these reforms are: (1) promote fuel diversity and development of US domestic resources; (2) pursue technologies, particularly cleaner-burning coal, that both reduce emissions and raise efficiency; (3) encourage US participation in international agreements that address other environmental concerns, e.g., chlorofluorocarbons and nitrogen oxides; (4) help restore public confidence in nuclear power; and (5) promote an industry structure that allows increased competition, but only if adequate and reliable power is provided economically. Mr. Kuhn states that generation by third-party sources has climbed 575% since 1979 and now accounts for 3.5% of capacity. Further, he says the utility industry supports enhancing all power-supply options, but regulations must be reasonable and workable.

40368 (CONF-8810273–, pp. 9, Paper 7) **Three major issues confronting Japan's electric companies.** Mizuno, W. (Tokyo Electric Power Co. (Japan)). Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; Mauna Kea, HI (USA); 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

The author points out that the Japanese electric power industry, which has enjoyed relative stability the past few years, is now concerned because: (1) demand for electric power has recently been rising at a rate greater than expected; (2) activities of the anti-nuclear power movement have increased, posing a threat to stable power supplies; and (3) increasing scrutiny is now being given to the environmental problems associated with energy use. He feels that nuclear power can go far in alleviating (3) and notes that 70% of Japan's generation is now by nuclear, hydro, and LNG. Also, he observes that in devising the best ways to save energy, one should not merely economize on energy use but adopt measures that make possible the coexistence of energy conservation and economic development.

40369 (CRIE–Y-88014) **Changes of energy situation and R and D activities of electric power technologies.** Uchiyama, Yoji. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Nov 1988. 38p. (In Japanese). Order Number DE89772360/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Abailable from Central Research Inst. of Electric Power Industry, Tokyo (Japan).

The effect of changes in energy situation from the time of the oil crisis up to the present time on the developement of new energy technologies was studied. The object of the study was limited to electric power generation technology which was analyzed from the economical point of view. Perspective of future power generation technology developement was also studied based on the recent stable energy situation. Although it is believed that the development of new technologies acted to prevent the raise of petroleum price at the time of the past two oil crises, the only technology introduced to the commercial plant by now in these 15 years is the LNG composite power generation. Alternate technologies for petroleum contain economically adverse factors, and the development effort for the reduction of cost is a requirement. In the field of introduction of thermal technologies centering around the LNG thermal power, efficient use of overage thermal power plants can be economically advantageous. For the power generation technlogies utilizing natural energy, reduction of the construction cost is the necessity. 17 figures, 10 tables.

40370 (DOE/EIA–0226(89/04)) **Electric power monthly, April 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 18 Jul 1989. 178p. Sponsored by U.S. DOE Management & Administration. Order Number DE89015735/JAW. Available from NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.

This report is prepared by the Electric Power Division; Office of Coal, Nuclear, Electric and Alternate Fuels; Energy Information Administration (EIA); Department of Energy. The purpose of this publication is to provide energy decisionmakers with accurate and timely information. The EPM presents monthly summaries of electric utility statistics at the national, Census division, and state level for net generation, fuel consumption, fuel stocks, quantity and quality of fuel, cost of fuel, electricity sales, and retail prices of electricity. Data on net generation are also displayed at the North American Electric Reliability Council (NERC) region level. Additionally, company and plant level information are published in the EPM on capability of new plants, net generating, fuel consumption, fuel stocks, quantity and quality of fuel, and cost of fuel. Quantity, quality, and cost of fuel data lag the most net generation, fuel consumption, fuel stocks, electricity sales, and retail prices data by 1 month. This difference in reporting appears in the national, Census division, and state level tables. However, at the plant level, all statistics presented are for the earlier month for the purpose of comparison. 1 fig., 37 tabs.

40371 (DOE/EIA–M039) **Model methodology and data description of the Electricity Market Module: Volume 2, Planning component.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. Jun 1989. 126p. Sponsored by U.S. DOE Management & Administration. Order Number DE89015159/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Electricity Market Module (EMM) is a computerized model of the electric utilities industry. It is a component of the Intermediate Future Forecasting System (IFFS), which is used to provide year-by-year projections of energy markets. This report documents the version of the EMM used in the IFFS model to produce forecasts for the "Annual Outlook for US Electric Power 1989", the "Annual Outlook for US Coal 1989", and the "Oil and Gas Annual Fuels Outlook 1989" and "Electricity Generation from Natural Gas: Prospects and Implications for the United States". Previous versions of the EMM have already been documented. The model has been updated and modified since the original documentation was published. This updated and modified since the original documentation was published. This updated documentation has been developed to comply with requirements set forth in the Energy Information Administration Order EI-5910.3A, "Guidelines and Procedures for Model Documentation", October 1985. This report and its companion volumes describe the methodology and data used in the EMM model. The documentation is intended for energy analysts and others interested in specific information on how EIA develops projections for the electric utilities industry.

40372 (EPRI-P–6369) **Assessing supply and demand uncertainties: Final report.** Oatman, E.N.; Talbert, T.L. Electric Power Research Inst., Palo Alto, CA (USA); Strategic Decisions Group, Menlo Park, CA (USA). c Jun 1989. 20p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Higher than projected electricity demand in recent years has caused concern that existing generating capacity may reach its capability limits with the next two decades, but the uncertainty of future electricity demand has made utility planning difficult. Deregulation, competition, nonutility generation, and supply- and demand-side bidding add to utility planning uncertainties. This report assesses uncertainty in US electricity supply and demand to the year 2010, provides a probabilistic projection of supply and demand for various planning options, and shows how various combinations of options could contribute to a national supply and demand balance. The range of uncertainty for these options is discussed in terms of flexibility, impact, and risks. The report is based on supply and demand information from industry literature, technical journals and reports, and industry experts. It includes electricity demand forecasts from such organizations as Data Resources, Inc., DOE, Edison Electric

Institute (EEI), and Gas Research Institute, as well as findings from EEI's Electricity Futures study. 11 figs., 3 tabs.

40373 (EPRI-P-6385) **MIDAS case studies.** Brusger, E.C.; Farber, M.A.; Sharpe Hayes, M.M. Electric Power Research Inst., Palo Alto, CA (USA); Temple, Barker and Sloane, Inc., Lexington, MA (USA). c Jul 1989. 140p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This series of three case studies illustrates the validity and usefulness of MIDAS, a microcomputer-based tool for integrated resource planning under uncertainty. The first, at Union Electric, serves to test and validate the model and to illustrate its use for demand/supply option evaluation. Focusing on nuclear plant life extension, the Virginia Power case demonstrates the model's extensive detail, particularly in the production cost and financial areas, as well as its flexibility in addressing approximately 70 uncertainty scenarios. Puget Sound Power & Light, the third case, used MIDAS for the preparation of its integrated resource plan. A 108-endpoint decision tree illustrates the full power of the decision analysis capability.

40374 (ESC-WR-89-11) **CO_2 emissions resulting from different scenarios for electric power generation in the Netherlands.** Okken, P.A. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Jun 1989. 45p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Using fossil fuels for electric power generation results in direct CO_2 emissions, which contribute to the global warming of the atmosphere. The amounts released depend on the energy source used and the efficiency of the power generation process. If household refuse is used as fuel CO_2 emission depends on the fraction of synthetic material in the refuse. Indirect CO_2 emissions result from activities like mining, transport and preparation of the fuels and from construction (and use of construction materials) of the power plants. Reducing electric power demand reduces the CO_2 emissions; about 700 g of CO_2 per kWh. CO_2 emissions are calculated for the period 1990-2000 for different electric power generation scenarios. A 'coal' scenario may lead to an average CO_2 emission of 850 g per kWh and a 'nuclear power' scenario in as low as 350 g of CO_2 per kWh generated. 5 figs., 30 refs., 12 tabs., 1 app.

2980 Consumption and Utilization

Refer also to citation(s) 39895, 40362, 40364, 40370

40375 (DOE/EIA-0285) **Requirements for information on energy consumption in the commercial sector.** Oak Ridge National Lab., TN (USA). 22 May 1981. 464p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89015005/JAW. Available from NTIS, PC A20/MF A01 - GPO - OSTI; GPO Dep.

This paper contains several memoranda related to requirements for information on energy consumption. Also, included are reports titled: "Requirements for Information on Energy Consumption in the Commercial Sector;" and "Validation of Information Requirements for Commercial Sector Energy Consumption." Both of these reports are quite detailed and cover many specific topics. (JEF)

2990 Unconventional Sources and Power Generation

40376 (EUR-10387) **Study of the assessment of energy needs and the attitudes towards alternative energy sources.** Lentiri, F. Commission of the European Communities, Luxembourg (Luxembourg). 1986. 147p. (In Italian). Available from NTIS (US Sales Only), PC A07/MF A01.

The activity concerning the research programme will consist in: characteristics of present energy consumers (quantity and kind on an internal territory of Sicilia: - region of Madonie (about 40 km x 30 km), - region of Accamo (about 16 km x 20 km). This involves a total of 450 farms in an especially advantageous area; the characteristics of local energy sources (quantity and kind); the analysis of local energy needs (quantity and kind) with emphasis on improving the living conditions and developing the area; the evaluation of possibilities and aptitudes to use alternative energy sources. The following possibilities will be examined: - solar thermal technology (warm water, drying, etc) - biomass conversion technology (biogas, gasification, pyrolysis, etc.) - photovoltaic and wind energy production technologies for different applications such as light, pumps, drinking water, forest fire warning, irrigation monitoring systems, etc.); project for the realisation of small pilot plants.

30 DIRECT ENERGY CONVERSION

Refer also to citation(s) 40168

3001 MHD Generators

40377 (CONF-890671-3) **Performance of a multi-grid three-dimensional MHD generator calculation procedure.** Bouillard, J.X.; Krazinski, J.L.; Vanka, S.P.; Berry, G.F. Argonne National Lab., IL (USA). 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 27. symposium on engineering aspects of magnetohydrodynamics (SEAM); Reno, NV (USA); 27-29 Jun 1989. Order Number DE89015134/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes the formulation and the evaluation of a recently developed multigrid finite-difference calculation procedure for steady three-dimensional magnetohydrodynamic flows. This procedure solves in primitive variables the parabolized steady-state magnetohydrodynamic equation set which consists of the mass continuity equation, three momentum equations, the energy equation, the turbulence kinetic energy and dissipation rate equations, and Maxwell's equations using a full approximation storage block implicit multigrid finite-difference technique. This new technique is first validated by comparing predicted results with experimental data for a supersonic and a subsonic Faraday generator. The performance of this technique is then assessed in terms of computational speed and solution accuracy. 29 refs., 7 figs., 6 tabs.

40378 (DOE/ET/10815-T7) **Status of proof-of-concept testing at the Coal Fired Flow Facility.** Attig, R.C.; Sanders, M.E.; Chapman, J.N. Tennessee Univ., Tullahoma, TN (USA). Space Inst. 1989. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC02-79ET10815. Order Number DE89015802/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

Results of the POC testing at the DOE Coal Fired Flow Facility (CFFF) during calendar year 1988 are summarized. Emphasis is on the development of technology for the steam bottoming plant for the MHD Steam Combined Cycle power plant. The first 500 hours of corrosion testing on candidate boiler tubes were completed and preliminary results are discussed. Ash deposition and efforts to improve the removal of deposits by sootblowers are outlined. Results of testing the particulate control devices (baghouse and ESP) are included. Finally, plans for future testing are presented. 9 figs.

40379 (DOE/PC/79668-T4-Vol.2) **Conceptual design of a coal-fired MHD retrofit plant (Scholz Plant—Sneads, FL): Volume 2, Drawings.** Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div. Apr 1989. 56p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79668. Order Number DE89015743/JAW. Available from NTIS, PC A04/MF A01 - OSTI.

The US DOE/PETC is funding a conceptual design study to evaluate a coal-fired MHD retrofit plant of sufficient size to demonstrate the technical and economic viability of an MHD system operating within and electric utility environment. Westinghouse Advanced Energy Systems (WAES), via Contract No. DE-AC22-87PC79668, is responsible for the site-specific conceptual design of a coal-fired magnetohydrodynamic (MHD) retrofit of the Scholz Generating Station. The Scholz Generating Station is owned and operated by Gulf Power Company, a member of the Southern Electric System. WAES is directing a design team comprised of the following members: Southern Electric International (the architectural engineering arm of the Southern Electric System), University of Tennessee Space Institute (UTSI), Seitec Inc., HMJ Corporation, STD Research Corporation, and Westinghouse R&D.

40380 (DOE/PC/79672–T1) **MHD seed recovery and regeneration: Final report.** TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div. 14 Oct 1988. 317p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79672. Order Number DE89002711/JAW. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

The TRW Econoseed MHD Seed Regeneration Process is based on the reaction of calcium formate with potassium sulfate spent seed from an MHD electric power generation plant. The objectives of this Phase I project are to test the process at bench-scale, design a proof of concept (POC) test plant, plan and cost a Phase II project for a POC plant evaluation and prepare a conceptual design of a 300 MW (t) commercial plant. The results of the project are as follows: (1) each of the unit operations is demonstrated and the (2) data are incorporated into a POC plant design and project cost, as well as a 300 MW (t) commercial retrofit plant design and cost estimate. Specific results are as follows: (1) calcium formate can be produced at 100% yield in a total retention time of less than 5 minutes, (2) utilizing the calcium formate, spent seed can quantitatively be converted to potassium formate, potassium carbonate or mixtures of these with potassium sulfate as per the commercial design without measurable loss of potassium to insolubles at a total retention time under 20 minutes and ambient pressure, (3) the solid rejects form the process meet RCRA EP Toxicity requirements for safe disposal, and (4) filtration and evaporation data, as well as reaction data cited above, show that the Econoseed technology is ready for scale up to POC plant scale. Economics forecast studies show that the total cost per unit of potassium for seed regeneration by the Econoseed Process is in the range of $0.23 to $0.27/lb, a cost which is less than half the potassium cost of $0.63/lb for purchasing new potassium carbonate. 4 refs., 47 figs., 41 tabs.

3005 Fuel Cells

Refer also to citation(s) 40124

40381 (CRIE–T-87067) **Study of operation control method for MCFC power system. Development of pressurized test stand for MCFC.** Isaki, Yoshiyuki; Watanabe, Takao. Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Technical Lab. No. 1. Sep 1988. 28p. (In Japanese). Order Number DE89772382/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan.

Based on the fundamental study about the pressurized control method which is considered to be most important for pressurized operation of MCFC (molten carbonate fuel cell), a pressure test system was developed for the study of pressurized control method. It was confirmed that the pressure difference between the pressures of vessel, anode and cathode must always be controlled whthin several hundred mm H_2O. A small pressure test device was developed and various kinds of operations (changes in gas flow and composition, etc.) were carried out. It was confirmed that the difference in the pressure was approximately 80 mm H_2O as the maximum. The pressure control method applied this time to the pressure test system was verified to be effective for the pressurized operation of MCFC in the future, and the basic functions of the test system were confirmed. 15 figures, 4 tables.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

Refer also to citation(s) 40147, 40322, 40821

40382 (BFR-D–1-1989) **Compression/absorption cycles for large heat pumps. System simulations.** Aahlby, L. Swedish Council for Building Research, Stockholm (Sweden). 1989. 125p. Order Number DE89902422/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

In this work three different compression/absorption cycles, using a mixture of ammonia and water, were simulated. From the beginning the three mixtures H_2O/LiBr, CH_3OH/LiBr and NH_3/H_2O were considered but since NH_3/H_2O gave the better performance it waas chosen for the further study. The three cycles were chosen with the intention to achieve an improved performance for three different situations: - when the temperature gradients of the heat sink and the heat source are large and of the same magnitude, - when the temperature gradient of the heat source is large compared to the gradient of the heat sink, - when a large temperature lift is required. A comparison between the compression/absorption cycle and a compression cycle working with the optimal refrigerant within each temperature range shows an improvement in COP for the former cycle ranging from 0% to 30%. The specific capacity shows an even larger improvement for the compression/absorption cycle, between 35% and 55%. When considering the compression/absorption cycle in different case studies the greatest improvement is achieved for the industrial cases where the temperature level is high. Also at lower temperature levels there is an improvement for the situations where the temperature gradients of the sink and the source are large. (With 31 refs.).

40383 (BFR-D–3-1989) **Blocks of flats with glazed verandas, Taberg. Analysis of energy and internal climate.** Fredlund, B. Swedish Council for Building Research, Stockholm (Sweden). May 1988. 244p. Order Number DE89902397/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

This project refers to four two-storey blocks of flats with their associated garage buildings, store rooms and communal premises/ laundry room. Each building comprises eight flats. The southerly facades with their glazed verandas are a characteristic feature of the development. It is found that the flats at Taberg have a good energy economy. The main reason for this is the high standard of insulation in combination with direct acting electric heating which has a regulatory system that reacts rapidly to adventitious gains energy. The verandas are of subordinate importance for the energy consumption by the flats. The design energy consumption for space heating is in good agreement with that obtained from an energy balance drawn up on the basis of measurements, ca 60 kWh/m^2 annually. This may be compared with the energy consumption of 93 kWh/m^2 annually in a building constructed to the standards of the Swedish Building Code SBN 80, without glazed verandas. (With 34 refs.).

40384 (BFR-R–2-1989) **Freeze protective measures for air heaters.** Braennstroem, H. Swedish Council for Building Research, Stockholm (Sweden). 1989. 45p. (In Swedish). Order Number DE89902424/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The main object of the project was to find out how freeze protective measures are described in tender request documents and also to elucidate freezing causes. The number of freezings has decreased over the years, relatively seen, mainly because of improved technique but freeziznqs are presently estimated at between 3000-4000 per year with a corresponding cost of MSEK 40-50. By the freezings investigated (65) it was found that air in the heating systems and interruption in electricity supply were topping the list of freezing causes. Of the tender request documents examined it is clear that most designers have a poor insight in the freeze protection questions, which in turn results in an inferior freeze protection. The report elucidates the problem from different aspects and presents suggestions for freeze protective measures.

40385 (BFR-R–4-1989) **Power measurement on heat pumps. Simplified method of measurement.** Fahlen, P.; Johansson, K. Swedish Council for Building Research, Stockholm (Sweden). 1989. 80p. (In Swedish). Order Number DE89902425/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

In connection with guarantee control and settling of state of heat pump installations there is a very great need for simple and rapid methods of evaluation. A method has been suggested where the evaluation can be carried out by measurements in the refrigerant loop, and measurement of electric power. In this way the most expensive moment in a normal energy measurement is avoided, i.e. the determination of the flow rate. A portable set for this type of measurements has been developed. The aim of the project was to decide wheather a simplified performance testing of heat pumps by measurements in the refrigerant loop is possible and, if so, at what accuracy. Measurements were done on a number of heat pumps

both in laboratory and in existing installations. By means of a test rig the brine and the heat carrier temperatures could be controlled with high accuracy. According to the theory of the procedure, the coefficient of performance can be calculated from two pressure measurements and three temperature measurements, and by means of the measured electric power the thermal power yield can then be estimated. The prerequisite is some assumptions about the compressor efficiency. The results of the measurements show that the equipment tested in most cases managed to estimate the coefficient of performanc within +5%of the correct value. This result corresponds well with the theoretical judgements done. The investigations also show that the method is independent of superheating, subcooling, evaporation temperature, and condensation temperature, provided superheating and subcooling are sufficiently high.

40386 (BFR-R-7-1989) **Dwellings as user controlled energy systems. Studies of variation in energy use in an area for low energy housing.** Lundgren, T. Swedish Council for Building Research, Stockholm (Sweden). Dec 1988. 153p. (In Swedish). Order Number DE89902427/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Long English summary.

The origin of this study is the large variation in energy use which is commonly observed within groups of nominally identical dwellings exposed to the same climate. This variation can in principle only be explained by the ways in which the dwellings are used. The purpose of this study is not only to explain variation in energy use, but also to analyze constraints and opportunities for users to save energy. The study is carried out in an experimental demonstration area for low energy housing which was developed in the beginning of the 1980's. The dwellings are autonomous units of energy use with direct-acting electric heating and separate systems for mechanical ventilation (with heat recovery) and for hot-water supply. Energy analyses in the study are based on manual weekly readings of electric energy use, internal temperature and water consumption Readings were initiated in the autumn of 1981 and continued almost three years until the summer of 1984. Linear multiple regression at the group level shows that external temperature and solar radiation in the case of winter explain between 55 and 75% of variation in weekly energy use, depending on type of dwelling. Internal temperature and water consumption explain 65-68% of residual variation in the row houses (two types) and 50-51% in the apartments (two types). Average saving effect in the case of winter is calculated to be 190 W for the row houses and 140 W for the apartments, which corresponds to a difference in internal temperature of 2 deg C. Solar utilization, i.e. actual saving from solar radiation as compared to potential, is estimated to be 65% for the row houses and 75% for the apartments. Solar utilization is roughly the same during periods of little sun as during sunny periods. (With 28 refs.).

40387 (BFR-R-10-1989) **Heat recovery from Storgruvan, Norberg.** Laurin, L. Swedish Council for Building Research, Stockholm (Sweden). 1989. 25p. (In Swedish). Order Number DE89902428/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report presents the outcome of a heat pump system with water from a mine as heat source. The total installed heat pump power comes to c. 450 kW. As a mean c. 230 kW has been extracted from the heat source. A temperature lowering of 1.7-2 deg C of the mine water by the heat extraction mentioned has been measured. This is considered the maximum temperature lowering that the system should attain. At this level no re-loading of the mine with heat will be necessary. The economic analysis was carried out for 1985-1987. Because of energy cost development (lowered oil prices) the plant has not yielded any profit.

40388 (BFR-R-14-1989) **Evaluation of an exhaust air source heat pump at the Moerby centre.** Naumburg, P.H. Swedish Council for Building Research, Stockholm (Sweden). 1989. 39p. (In Swedish). Order Number DE89902430/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Results from measurements on a large exhaust air source heat pump connected to the heating system for the 'copper buildings' close to the Moerby centre are shown. The total living area amounts to 15696m^2. The heat pump has a condenser power of c. 220 kW and operates with R22 refrigerant (chlorine-difluorine methane). The exhaust air is cooled by six heat exchangers. Ethylene glycol plus water is used as brine. Two types of measurements were done, long term measurements where readings were taken weekly and what is called 'campaign measurements' in the form of more accurate measurements for 7-10 days. The latter were performed on three different occasions during different times of the year. Estimates based upon the campaign measurements indicate that the heat pump should be able to supply heat for all hot water and for slightly more than 40% of the yearly space heating demand.

40389 (BFR-R-16-1989) **Inquiry of heat pumps in the Danderyd municipality.** Melinder, Aa.; Naumburg, P.H. Swedish Council for Building Research, Stockholm (Sweden). 1989. 47p. (In Swedish). Order Number DE89902431/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

To ascertain the practical functioning of heat pumps after some years of operation a number of heat pump owners were interviewed three years in succession. The number of answers were 99, 93 and 87 respectively. At the first inquiry round the heat pumps had been in operation for two years on an average. The interviews give information of i.a. the owner's view of his heat pump, need for service, energy demand, and advice to those who are planning a heat pump installation. At the last inquiry round 64% were of the opinion that the heat pump performance agreed with what was promised and 93% were satisfied with their heat pumps. These figures were 12% lower than the year before. The malfunction frequency was by the first inquiry c. 20% lower with geothermal heat than with other heat sources. The main malfunction reason was leakage. The number of malfunctions the last year was by the last inquiry round noticeably lower than by the two earlier rounds. Reasons may be that the heat pumps have recovered from some 'children's diseases', but also that guarantee periods and service agreements had expired for most of these heat pumps. The latter fact is probably also the primary cause for more and more people to pay for service visits out of their own pockets. Distributed on all interviews for the different inquiry rounds the sums correspond to a mean cost of c. SEK 15, 350 and 510 respectively.

40390 (BFR-R-18-1989) **Cold transfer fluids for heat pump applications. Thermodynamic properties and corrosion for potassium carbonate, and comparison with other cold transfer fluids.** Melinder, Aa.; Berendson, J.; Granryd, E.; Kyrk, B. Swedish Council for Building Research, Stockholm (Sweden). 1989. 100p. (In Swedish). Order Number DE89902470/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report presents results of investigations of thermodynamic substance constants for carbon carbonate/water solutions. Diagrams are shown for freezing point, density, viscosity, specific heat, thermal conductivity, coefficient of volumetric expansion, surface tension, boiling point and vapor pressure. A comparison of different cold transfer fluids with respect to transport and heat transfer properties demonstrates potassium carbonate to be superior to glycols and alcohols but slightly inferior to clorides. More than two years field experience of inhibited potassium cloride as a cold transfer fluid has demonstrated good results from corrosion point of view. General corrosion can be controlled by addition of a suitable corrosion inhibitor. Zinc and aluminium and soft solder should be avoided in a system containing cold transfer fluids based upon potassium carbonate. Because of risk for localized corrosion, immersion tubes and movable parts should not be made of brass. Carbon and stainless steel are suitable materials of construction. (With 45 diagrams).

40391 (CONF-890898-1) **Second-level post-occupancy evaluation (POE) analysis.** Collins, B.; Fisher, W.; Marans, R.W. National Inst. of Standards and Technology, Gaithersburg, MD (USA). 14 Feb 1989. 32p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-88CE21027. From IES annual conference; Orlando, FL (USA); 6-10 Aug 1989. Order Number DE89014520/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Findings from a detailed analysis of post-occupancy evaluation data, sponsored by LRI, which involved thirteen office buildings typical of current design practice, will be discussed. Analysis of the data indicates that occupant satisfaction can be related to type of lighting system, presence of daylight, and patterns of luminance in the office. 15 refs., 9 figs., 3 tabs.

40392 (ECRC/R–2290) **Protection and installation of heating tape in domestic premises.** Stephen, F.R.; Dunn, B. Electricity Council Research Centre, Capenhurst (UK). Apr 1989. 34p. Available from Available from: Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

Electric trace heating is an efficient, economical and safe method of maintaining the temperature of hot water in distribution pipework. In domestic premises it is particularly important that people and premises are protected from any faults or damage that may occur during the lifetime of the trace heated system. Tests were carried out on a self-regulating heating tape which was subjected to gross abuse to determine the performance of protection devices that are typically found in the home. Results show that protection against fault conditions can be obtained by using correctly rated fuse links to BS.1362, together with a residual current device. Recommendations on the specification and installation of protection devices for trace heating systems in domestic premises are given. (author).

40393 (EUR–10550) **Contribution to the improvement of planning criteria in industrial buildings through the rational use of energy needed for space heating.** Anon. Commission of the European Communities, Luxembourg (Luxembourg). 1986. 76p. (In Italian). Available from NTIS (US Sales Only), PC A05/MF A01.

At present, energy consumption for space heating of industrial buildings is an important amount of the total energy balance in the industrial countries. Several energy saving investigations carried out on industrial plants emphasized important in efficiencies in space heating. These inefficiencies may be reduced through a better design of the building-systems. This investigation aimed to determine criteria both for design of new industrial buildings and for retrofit on existing ones.

40394 (EUR–10905) **Evaluation of the effects of energy rehabilitation in two schools of the Lombardy region.** Zabot, S.; Bhargava, A.K.; Fumagalli, S.; Soma, L.; Conti, F.; Mahajan, S. Commission of the European Communities, Luxembourg (Luxembourg). 1987. 109p. (In Italian). Available from NTIS (US Sales Only), PC A06/MF A01.

This report which is in the result of the collaboration of 3 groups-Lombardy Region Education Sector, ENEA-FARE (Ispra Engineering Division) and the Commission of the EC (CCR-Ispra)-illustrates the results of monitoring 2 educational establishments, the elementary schools at Montorfano (CO) and at Lanzada (SO), which were fitted with solar heating equipment. There were 2 aims: a cost-benefit analysis and improvement of data-gathering which would in turn lead to improvement of energy usage. Data were gathered on the strategies used in the schools; the methodology is briefly described for the gathering and analysis of data; finally, there is a critical analysis of defects and possible remedies, both of the installations themselves and of the data. Three appendixes contain detailed data.

40395 (ITL–8509, pp. 416-420) **New phase-change thermal energy materials for buildings.** Benson, D,K. (Solar Energy Research Inst., Golden, CO, USA); Christensen, C.B.; Burrows, R.K.; Shinton, Y.D. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A new class of phase-change thermal energy storage materials is under development. They reversibly absorb large amounts of heat during a solid-state, crystal transformation more than 70^{0}C below their melting temperatures, and their solid-state transformation temperatures may be adjusted over a range from 7 to 188^{0}C by varying the ratios of binary mixtures of the components. Because these storage materials remain solid throughout the range of their service temperatures, unique opportunities exist for incorporating them into building materials. Composites have been made with ordinary, porous construction materials such as wood, gypsum board, and lightweight concrete as the matrix and with the solid-state phase-change materials filling the void space. The thermal storage capacities of such composites are thereby increased by more than 100% without changing the basic nature and workability of the matrix construction material. Parametric analyses have been conducted to determine what combination of properties would be optimum for certain solar and energy conserving building applications including Trombe wall, direct gain, and distributed cool storage (combined with night ventilation). 6 refs., 4 figs., 1 tab.

40396 (LUTEDX-TEEM–1032-1-162-1985) **New ultrasonic flow meter. Modification of the sing-around method for use in heat meters.** Delsing, J. Lund Univ. (Sweden). Dept. of Electrical Measurement. 1985. 168p. Order Number DE89902410/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

A new ultrasonic flow meter using a modified sing-around method has been developed especially for use in small heat meters. In such applications the fluid temperature often varies rapidly which strongly changes the speed of sound. As a result of this serious errors are introduced into the flow measurements made with the conventional sing-around techniques. In the present method the fluid velocity is evaluated by a new algorithm. With this algorithm correct flow velocities are obtained even in the case of rapidly changing fluid temperature. Further the dynamic range of the flow meter is increased appreciably by the use of ultrasound transducers with suitable geometry. At the beginning of the paper the requirements governing the design of the flow meter are discussed in detail as well as the error sources. After the development of improved algorithm the design of the flow meter body as well as electronic circuitry is described, where a special zero crossing detector is used to improve the accuracy and the dynamic range of the meter. Finally, preliminary results of the test measurements with the flow meter are reported which show the strongly improved meter accuracy for flow with rapid temperature changes. For the new flow meter a velocity range of 3.5 cm/s $\pm$5% (10 l/h in a diam 10 mm pipe) to 140 cm/s $\pm$0.5% (400 l/h in a diam 10 mm pipe) has been proven. (With 26 refs.).

40397 (ORNL/CON–263/V1) **Evaluation of implementation, enforcement and compliance issues of the Bonneville Model Conservation Standards Program: Volume 1.** Cantor, R.A.; Cohn, S.M. Oak Ridge National Lab., TN (USA). Jul 1989. 150p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89014348/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report examines the activities of a sample of five participants in Bonneville's Model Conservation Standards (MCS) program. The MCS were designed to ensure that all new electrically-heated buildings located in the Bonneville power system area would conform to cost-effective standards of energy efficiency. Three primary objectives guided our research into the key issues of the MCS program: to understand the major effects of the MCS on enforcement activities, including an evaluation of incremental time and cost associated with enforcing the MCS in adopting jurisdictions; to explore the effects of MCS-related enforcement activity on (1) field compliance levels achieved, and (2) electricity savings within adopting jurisdictions; and to identify obstacles to participation in the Early Adopter program and, ultimately, successful implementation of the MCS in the region. 12 refs., 1 fig., 39 tabs.

40398 (ORNL/CON–263/V2) **Evaluation of implementation, enforcement and compliance issues of the Bonneville Model Conservation Standards Program: Volume 2: Technical report and appendices.** Cantor, R.A.; Cohn, S.M. Oak Ridge National Lab., TN (USA). Jul 1989. 23p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89014349/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This technical report expands several issues raised in Volume 1 of the Early Adopter program evaluation. These issues were important to the analyses of Volume 1, but their explanations involved more detail than was necessary for the general reader. Therefore, rather than relegate the issues to a technical appendix or refer the reader to other sources of the information, we decided to address them in a separate technical report. In the following sections, we

discuss: (1) an analysis of opportunity and accounting costs; (2) detailed infiltration results; and (3) the electricity simulation models. 4 refs., 3 figs., 8 tabs.

40399 (SIB-TN–2) **Effects of surrounding buildings on wind pressure distributions and ventilation losses for single-family houses. Part 2: 2 storey terrace houses.** Wiren, B.G. Statens Inst. foer Byggnadsforskning, Gaevle (Sweden). Mar 1987. 56p. Order Number DE89902401/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This report describes a wind tunnel investigation of wind pressure distributions over a 1:100 scale model of a row of five 2-storey, flat-roofed terrace houses. Measurements were made with the instrumental model either fully exposed to wind from all directions or surrounded by identical rows of houses in various regular arrays. Time mean pressures were measured at 300 locations on the model walls in a simulated turbulent wind. The wind angle was varied between 0 and 90 degrees in increments of 15 degs. Pressure coefficients obtained from the tests were used for the calculation of air change rates and associated heat losses from a naturally ventilated full-scale house for a range of wind speeds, u, and internal-external temperature differences, ΔT. In these calculations the air leaks were assumed to be uniformly distributed over the building envelope. The leakage area was chosen to give, for an end unit of a wind-exposed row of houses, an air change rate of 0.45 l/h at u = 3 m/s and ΔT = 20 deg C, which approximately corresponds to the minimum requirements as stipulated in the Swedish building regulations. Surrounding buildings affect both the magnitude and the distribution of wind pressures over the test house. The resulting change, ΔQ, in the ventilation loss, normalized with the loss, Q_o, from the test house in a wind-exposed position, is used to characterize the various building arrays with respect to their sheltering effect on the test house.

40400 (SIB-TN–5) **What's the price for heat ?. Technical analyses of heating plants.** Edstroem, S. Statens Inst. foer Byggnadsforskning, Gaevle (Sweden). Jan 1988. 65p. (In Swedish). Order Number DE89902404/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Technical analyses of design and function of 25 heating plants in apartment buildings were carried through. The plants were of the following types: Oil, oil + electricity, oil + heat pump, oil + solid fuels. They were studied concerning installed effect, required effect, efficiency, etc. The final results show that it can cost three times as much to produce heat in a poor plant compared to in a good one. The variations do not depend on type of plant but rather on the high frequency of deficiencies e.g. concerning: - the size of the plant (often too large), - the design and installation, - operation and maintenance. Interest and knowledge on part of the property owners differ considerably. The same goes for the operating staff. Some property owners do not know how much energy the building uses and thus they do not have a grasp of whether the plant functions well or not. (author).

40401 (SIB-TN–7) **Estimation of peak load demands in buildings using measured data.** Hammarsten, S.; Hjalmarsson, C. Statens Inst. foer Byggnadsforskning, Gaevle (Sweden). Aug 1988. 94p. (In Swedish). Order Number DE89902399/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

In this report several methods are discussed that use measured data to determine peak load demands in buildings. Measurements of energy flows and temperatures have been done in eight electrically heated single-family houses from three different regions of Sweden. The houses have been occupied throughout the measurement period. The different methods have been compared with each other and with calculations according to the Swedish Building Code. Measurements from an extremely cold period in January 1987 have been used as a reference period. The two currently most common methods give overestimates of the peak load demand in the order of 10-20%. An energy-signature model with weekly data from at least 10 weeks tend to give underestimates around 10%. An improved treatment of the energy use for hot water production will eliminate this error. Under good measurement conditions a total measurement period of 1-2 weeks will be sufficient if dynamic models are used. But then hourly data are necessary.

40402 (SIB-TN–8) **Ventilation loss and passive solar heat gain in a Swedish housing estate: The influence of local climate, orientation and windbreaks.** Wiren, B.E.; O'mara, A.H. National Swedish Inst. for Building Research, Gaevle (Sweden). Sep 1987. 51p. Order Number DE89902442/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Wind tunnel tests have been carried out with a 1:250 scale model of a Swedish housing estate to determine external wind pressure distributions over the building walls. The estate is situated in flat, fairly open terrain and comprises 22 two-storey, multifamily houses. The effect on the pressure distribution of a simulated vegetation belt around the estate was also studied in the tests. Pressure coefficients obtained from the tests were used, together with climatological data, for the calculation of heat losses associated with natural ventilation of the buildings during the period October through April. In these calculations the air leakage was assumed to be uniformly distributed over the building walls. The leakage area was chosen to give an air change rate of 2 h^{-1} at a pressure difference of 50 Pa. To illustrate the influence of local climate conditions on the ventilation loss, three alternative sets of climatological data were used for the calculations. The effect on the ventilation loss of varying the orientation of the estate has been determined for the three sites, as well as the reduction of ventilation loss due to a 4 or 8 m high vegetation belt around the estate. Transmission losses and passive solar heat gains have been estimated for the three sites. A simple relationship is suggested for estimating the ventilation loss for a group of parallel buildings of equal height. (With 17 refs.).

40403 (SIB-TN–10) **Comparison of measured and calculated annual energy consumption in buildings.** Hjalmarsson, C. Statens Inst. foer Byggnadsforskning, Gaevle (Sweden). Nov 1988. 57p. (In Swedish). Order Number DE89902400/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This paper compares five methods for calculating annual energy consumption in buildings with measured annual consumption. The survey comprises 154 single family houses and 176 multifamily houses, distributed throughout Sweden, heated with oil, electricity or district heating. The calculating methods give great random error for a single house.

40404 (SV-UL–89-3) **Alternative cooling agents, a comparison between R500 and R152a in a small heat pump.** Lundstroem, A. Swedish State Power Board, Aelvkarleby (Sweden). 25 Jan 1989. 45p. (In Swedish). Order Number DE89902441/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

As a part of an investigation of alternatives to R12 that have less influence on earth's ozone layer a theoretical and practical comparison of cooling agents was carried out. The theoretical comparison was done between the cooling agents R12, R22, R500, R134a and R152a. The study shows that R22 has the highest condensing power followed by R500. R12, R134a and R152a have the lowest power and lie close together with small mutual variations. By practical testing in a small heat pump with standard components, no technical complications were noticed with R152a. For comparison R500 was tested. With R152a the condenser power decreases by 20% in comparison with R500. The coefficient of performance increases by 10%. (With 14 refs.).

40405 (TRITA-BYTE-AR–1987-2) **Reconstruction and supplementary thermal insulation of flat roofs.** Andersson, P. Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Byggnadsteknik. Mar 1987. 183p. (In Swedish). Order Number DE89902403/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The report describes an experimental and theoretical investigation of a new method involving exterior insulation and closed ventilation gap. In this way both thermal insulation and moisture conditions are improved. The aim of the investigation was to study how exterior supplementary insulation should be performed (methods of production, detailed solutions etc.) and how the roof construction has functioned from building physics point of view. Special interest was given to how the moisture conditions in the original roof construction were influenced by exterior insulation and closed ventilation gap. Important conclusions: - Exterior supplementary insulation and closed ventilation gap improves the thermal insulation ability and decreases by that the heating requirements. - The supplementary

insulation to a temperature increase in the original construction resulting in decreased relative humidity. This results in a drying of the construction, i.e. the moisture ratio is decreased. - The ventilation gap should be closed at a moisture ratio less than 15% to achieve full effect of the supplementary insulation. - The method offers a simple production technology with good availability and economy. - The risk of fire propagation in built-up areas is decreased. The closed ventilation gaps results in a hampered fire propagation between attic rooms via the eaves. The supplementary insulation results in a slower burning of the original tightening layer, which also makes fire propagation difficult. - With bevelled supplementary insulation it is possible to improve the pitch towards the drains. This also involves decreasing heat resistance against valleys and roof sinks, which creates more favourable chances for melted snow to run off the roof. (With 42 refs.).

40406 Determination of ventilation efficiency based upon short term tests. Anderson, R. (Solar Energy Research Inst., Golden, CO (USA)). v. of Effective ventilation. Proceedings of the 9th AIVC conference on effective ventilation (held at Novotel Hotel, Gent, Belgium, 12-15 September 1988). AIVC, Coventry, GB (1989). (CONF-8809127–: 9. AIVC conference on effective ventilation, Ghent (Belgium), 12-15 Sep 1988; AIC-PROC–9-88-1).

Conference published in 2 v.

A short term testing methodology is developed to evaluate the performance of ventilation systems with respect to control of indoor air pollutants. Two efficiency measures, displacement efficiency and removal efficiency, are defined based upon analysis of mass transport into and out of a specified control volume.

40407 Commercial building ventilation measurements using multiple tracer gases. Fisk, W.J. (Lawrence Berkeley Lab., CA (USA)); Prill, R.J.; Seppaneni, O. v. of Effective ventilation. Proceedings of the 9th AIVC conference on effective ventilation (held at Novotel Hotel, Gent, Belgium, 12-15 September 1988). AIVC, Coventry, GB (1989). (CONF-8809127–: 9. AIVC conference on effective ventilation, Ghent (Belgium), 12-15 Sep 1988; AIC-PROC–9-88-1).

Conference published in 2 v.

A unique multiple tracer experimental system has been developed and utilized within commercial buildings to monitor ventilation rates, air exchange efficiency, ages of air, flow rates of supply and outside air, and percent outside air in supply airstreams. The technique also makes it possible to determine the fractions of air at a monitoring point that entered the building through a particular air handler and by infiltration.

3202 Transportation

Refer also to citation(s) 40198, 40431

40408 (ETDE-mf–9794894) **Proof of the operational competence of the 'universal computer model'. Final report.** Kleemann, D.; Parsch, C.P. Institut fuer Bahntechnik G.m.b.H., Berlin (Germany, F.R.); Siemens A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Senator fuer Wissenschaft und Forschung, Berlin (Germany, F.R.). Dec 1988. 73p. (In German). Order Number DE89794894/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

The test results yielded by previous field-trials (TV 7510) were unsuitable for demonstrating the competence of computer programs simulating a complete direct-current short-distance rail transit system. Therefore new tests are being carried out at the UeSTRA in Hannover. Criterias for the test route selection, erection of testing facilities, the test program, the conducting of tests and assessing their values are described. The most important results are: 1. The evaluated series of measurements permit a conclusion to be made on the exactness of simulator programs within an average error margin of 1.5-2.0% according to measuring point and dimension. 2. Verification of the 'UNIVERSAL COMPUTER MODEL' could not be concluded within the tight time schedule. However results can still be counted on in 1988. 3. For the 'BASIM' Program presented by the Technical University at the second discussion held by experts, which also simulates direct-current short-distance transit systems, a visual comparison showed that the calculated voltage curves corresponded in principle to the measured values. These results show that verification of simulator programs is no unique procedure but a process reciprocating between fault-finding and failure elimination which leads to a suitable software product. (orig.).

40409 (ETDE-mf–9795080) **Simulation of the Berlin (West) S-Bahn ['Ringbahn']. Analysis of the alignment with a view to scheduling. Final report.** Beyer, W.H. Berliner Verkehrs-Consulting G.m.b.H. (BVC), Berlin (Germany, F.R.); Berliner Verkehrsbetriebe (BVG), Berlin (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Oct 1988. 87p. (In German). Contract BMFT TV 8623 A9. Order Number DE89795080/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A05/MF A01.

As the Ringbahn has been out of order since 1980 and since its re-opening cannot be expected within short, there are no authentic data available with regards to tracks and restricted speeds. Therefore, data of the 'Deutsche Reichsbahn' which were prepared between 1930 and 1960, have been evaluated, for since then there have been no major constructional changes. The line profiles of both directions of traffic have been analysed and recorded in tables. The most prominent gradients amount to 12.5 promille and have no influence to speak of on vehicle design and dynamics of vehicle movements. In particular cases the energy consumption will change (as compared with the first calculation for the level). Curvatures partly result in speed restrictions which, in accordance with the Railway Construction and Operating Regulations (EBO) Paragraph 40 (7) have been determined for both directions of traffic. When re-opening the system it is recommendable to investigate whether higher speeds are possible by making the guidance of bends more even. Speed restrictions due to structure damages could not be included in the analysis. It can be expected that these will have been repaired by the time of the re-opening. (orig.) With 39 figs., 6 tabs.

40410 (SAND–88-2380C) **Characterization of booster-rocket propellants and their simulants.** Weirick, L.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–21: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89008197/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A series of shock-loading experiments on a composite and an energietic propellant and there simulants was conducted on a light-gas gun. The initial objectives were to obtain Hugoniot data, to investigate the pressure threshold at which a reaction occurs, and to measure spall threshold at various impact velocities. The Hugoniot data measured for the propellants fit the Hugoniot curves provided by the manufacturer of the propellants extremely well and the Hugoniot curves developed for the simulants matched those of the propellants. Threshold pressures to initiate reactions in the composite and energetic propellants were found to be 40 and 3 kbars, respectively. In spall tests, the composite propellant and its simulant exhibited spall strengths around 0.25 and 0.18 kbar, respectively. The energetic propellant and its simulant were somewhat stronger with spall strengths just above 0.33 and 0.22 kbar. 12 refs., 6 figs., 6 tabs.

40411 (SAND–88-2596) **The effect of color and texture of foreground on size and distance perception using video systems for teleoperated vehicles.** Smith, C.U.; Miller, D.P. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 41p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014329/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Driving on typical streets offers people numerous visual cues such as lane markers and street signs to help navigate and make driving decisions. In off-road navigation, paths are not clearly marked; to traverse open terrains the driver must rely on gathering information about the surroundings, constantly searching for obstacles that might impede progress or damage the vehicle. Ability to judge the distance to an object, or the gap between obstacles, is helpful in choosing safe navigational routes. Interposing a video system between the driver and the environment compounds the difficulties of an already complex task. Not only does the teleoperator have the problem of navigating in an off-road environment, but he

must do so with a limited, distorted view of the surroundings. This study evaluates how well people perceive two objects of unknown size using monochrome and color television systems in three different terrains. Ten subjects estimated the size, distance, and clearance of the two objects using video tapes produced by a forward-looking, hand-held camera. Terrain variations included a field of grass, a barren construction site, and a high desert mesa. Results indicated that subjects typically underestimated distances and, when in error judging clearance, tended to overestimate the clearance between the objects. Color provided a slight advantage in estimating clearance over monochrome. Changes in terrain and the presence of color proved to have minimal influence on judging distances. This report describes the research methodology and the results obtained, and assesses the implications these findings have on teleoperated vehicle design. 12 refs., 4 figs., 6 tabs.

3203 Industry and Agriculture

Refer also to citation(s) 40100, 40176, 40375, 40427, 40428, 40448, 40680, 40681

40412 (CFS/NF–8710, pp. 136-163) **Explosion pulping of aspen.** Kokta, B.V. (Univ. du Quebec a Trois Rivieres, Trois Rivieres, PQ, Canada). Canadian Forestry Service, Edmonton, AB (Canada). Northern Forest Research Centre. 1987. (CONF-8710475–: Workshop on aspen pulp, paper and chemicals, Edmonton (Canada), Oct 1987; MICROLOG–89-01396). In *Proceedings of the workshop on aspen pulp, paper and chemicals.* Available from Northern Forestry Centre, 5320 - 122 Street, Edmonton, AB, Canada T6H 3S5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A new ultra-high-yield explosion process has been shown to be excellent for hardwood species such as aspen and birch. Paper properties of exploded aspen or birch pulps were increased by 50% when compared to those of chemico-thermal mechanical pulping (CTMP). Futhermore, defibration and refining energy decreased by 40 to 50%, while the brightness of exploded pulps rose from 5 to 10% in comparison to that of CTMP. Exploded aspen pulp can be bleached to an 85% level with 4% hydrogen peroxide, and the brightness stability was excellent. Defibration and refining in a laboratory blender leads to pulps and papers with paper properties and defibration energies almost identical to those obtained on pilot plant-size or industrial refiners. Finally, aspen or birch fibers are well-suited to reinforce thermoplastic polymers. Wood fiber-filled thermoplastic composites have generally surpassed those of glass fiber or mica-filled polymers. The estimated production cost of grafted aspen fibers or sawdust ($150-$500/ton) is more economical than in the case of silane treated mica ($700/ton) or glass fibers ($2,900/ton). 14 refs., 3 figs., 18 tabs.

40413 (DOE/CE/40637–T7) **Fundamental studies of black liquor combustion: Report No. 3, Phases 1, 2, and 3, December 1986–December 1987.** Clay, D.T.; Lien, S.J.; Grace, T.M.; Macek, A.; Semerjian, H.G.; Amin, N.; Charagundla, S.R.; Brown, C.N. Institute of Paper Chemistry, Appleton, WI (USA). Chemical Sciences Div.; National Inst. of Standards and Technology, Gaithersburg, MD (USA). Chemical Process Metrology Div. Apr 1989. 164p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CE40637. Order Number DE89014547/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The fundamentals of kraft black liquor combustion are being studied in a five year project. This report covers the completion of Phase 1 (In-Flight Processes) and initial results on Phase 2 (Char Burning) and Phase 3 (Fume Processes). The primary in-flight processes are drying and volatiles formation. Drying rate data could be interpreted with sample heat transfer models. Expansion of the drops during drying is significant and has a strong influence on drying rate in a high temperature environment. Char bed burning was studied using a char burning furnace module interfaces with the in-flight module on the IPC flow reactor. Initial experiments were characterized by a lack of a steady-state burning period and by O_2 stoichiometric control of the burning rate. Means for overcoming these problems were defined. A nonintrusive laser polarization ratio technique to measure fume particle size was successfully demonstrated. 40 refs., 70 figs., 41 tabs.

40414 (DOE/CE/90027–1) **Research on ultra low wear materials for energy conservation: Final report, September 30, 1988–June 30, 1989.** Burton, R.A.; Burton, R.G. Burton Technologies, Inc., Raleigh, NC (USA). Jun 1989. 26p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-88CE90027. Order Number DE89015096/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report summarizes a set of friction and wear measurements for glassy carbon based materials run against a broad range of counterfaces in ball on disk wear machines. The carbon based materials were operated as both riders and disks. The principal runs employed 1 N contact load, and special runs for the carbon on its own kind extended the load to 20 N. Runs were carried out in laboratory air and in dry nitrogen and argon. Wear was measured on the rider, alone. The general trend of the results showed favorably low wear coefficient for the carbon based materials. They showed much less sensitivity of the wear rate to the replacement of the air by dry nitrogen than would have been experienced by graphitic carbon.

40415 (DOE/ID/12626–2) **Ordered ceramic membranes: Annual progress report, March 1987–May 1988.** Anderson, M.A.; Hill, C.G. Jr. Wisconsin Univ., Madison, WI (USA). Aug 1988. 67p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AS07-86ID12626. Order Number DE89009027/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The properties of ceramic membranes prepared via the sol-gel process can be controlled by varying the suspension and interfacial chemistries of the precursor sols. The Year 1 Progress Report described the effects of changing several variables. This report presents results on the effect of sintering conditions on the properties of unsupported titania membranes. A description of the effect of phosphate addition on the preparation of alumina and titania membranes is also included, although this study is not yet complete. The preparation of silica membranes is also discussed. This second year of work has also included characterization of supported membranes, membranes which have been deposited on a support and then sintered to fix the membranes in place. These studies have involved measurements of the permeability of the supported membranes to various aqueous feed streams utilizing a laboratory scale test apparatus. PH and temperature effects on the flux of water through the membranes is described. Permselectivity measurements utilizing solutions of polyethylene glycol (PEG), bovine serum albumin, and cheesy whey, are also discussed. Because dissolution of membranes at extreme pH values can be a major problem in potential industrial applications, the stability of both unsupported and supported membranes at different pH values was determined. 9 refs., 22 figs.

40416 (EPRI-AP–6022) **Gas turbine characterization and diagnostic instrument evaluation: Final report.** Brawley, G.H. Electric Power Research Inst., Palo Alto, CA (USA); Battelle Columbus Div., OH (USA). c Jul 1989. 349p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This four-part report documents the major research activities and findings of a multiyear effort to develop, apply, and test new diagnostic instruments for large, heavy-duty gas turbine generators. The instruments developed and applied to gas turbines include: an Optical Fiber Thermometer (OFT) from Accufiber, Inc., a Combustion Viewing Probe (CVP) from United Technologies Research Center, a Turbine Bucket Temperature Measuring System (TBTMS, a.k.a. OP) based on an optical pyrometer from Solar Turbines, Inc., and a High Temperature RTD from Kaman Instrumentation. The research was sponsored by the Electric Power Research Institute (EPRI) in research project RP2102. The first part is an introduction to gas turbines and helps to define some fundamental relationships in typical electrical utility gas turbines. Also presented are the mathematical formulas that were used to characterize the gas turbine's operation. The second part describes the equipment used and gives a summary and characterization of the operation over the test periods from October 1985 through October 1987. The third part describes the special instruments and gives an evaluation of their use and results during the operation period. The fourth part describes special "envelope" tests that were performed toward the end of the program

to define the range of operation and common fault conditions. Finally, conclusions and recommendations are presented that draw from the larger experience of operating the instruments and monitoring effort for a long period. The primary benefit of the special instruments of this program is to make a periodic measurements online, rather than a permanently installed continuous basis. 24 refs., 94 figs., 15 tabs.

40417 (ETDE-mf–9794648) **Recovery of flue gas in the glass industry for charge preheating.** Zippe, B.H. Zippe G.m.b.H. und Co., Wertheim (Germany, F.R.). 1 Mar 1988. 139p. (In German). Contract BMFT 03E-8450-A. Order Number DE89794648/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A07/MF A01.

The total aim of the completed R+D project was to create a technical possibility for the glass industry for preheating the material to be melted before it is fed into one or more furnaces. This can be done with the help of the furnace waste gases, which so far has been released, more or less unused, into the atmosphere. A heat exchanger with indirect heating was developed and tested, which consists of laminar-arranged shafts, which are filled alternatively with the material to be melted or the charge (= mixture of different raw material for glass and/or cullets) and the waste gases. From the large-scale investigations, it can be concluded that the moisture of the charge plays an important role for the heating process. Operational disturbances such as baking can be avoided if the charge moisture is <0.125.soda content of the charge, e.g. if the charge undergoes preliminary dehydration. (orig./RB).

40418 (ETDE-mf–9795087) **Development of a European high-speed cycle.** Jost, P.; Sonnborn, K.S.; Waldeyer, H.; Hassel, D. Technischer Ueberwachungs-Verien Rheinland e.V., Koeln (Germany, F.R.). Inst. fuer Energietechnik und Umweltschutz; Umweltbundesamt, Berlin (Germany, F.R.); Verband der Automobilindustrie e.V. (VDA), Frankfurt am Main (Germany, F.R.). Jul 1986. 46p. (In German). Order Number DE89795087/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

The research project was to establish a European high-speed cycle for highways and expressways. The investigation was based on a statistical method for establishing driving cycles already tested in an earlier large-scale exhaust monitoring experiment. Data are presented on driving characteristics, and methods of establishing driving cycles are outlined. Four general cycles were established which could be matched by different middle-class cars on an exhaust test bench without any problems. The mean cycle speed was between 62 and 65 km/h for highways and around 96 km/h for expressways (diagrams). Finally, a German proposal for a European high-speed cycle for highways and expressways was presented in the form of diagrams supplemented by tables of statistical characteristic data. (HWJ).

40419 (EUR–9340) **Study of the possibilities of recovery of lost heat in thermal installations.** Brun, B.; Gaillet, J.P. Commission of the European Communities, Luxembourg (Luxembourg). 1984. 52p. (In French). Available from NTIS (US Sales Only), PC A04/MF A01.

This study reports a feasibility study of a process for recovering heat from crude distillation gas in a coke plant by means of an indirect gas-gas exchanger with pipes and grating. Trials at a pilot plant at the Marienau coke plant did not produce all the results anticipated. The feasibility of the process was not demonstrated completely. It was possible to pass crude distillation gas through the exchanger pipes by minimizing deposits from the point when the gas temperature remained constantly higher than the temperature at which coal tar condenses. It was not possible to conduct trials of a suitable duration. The amount of energy recovered was approximately 100 MJ per tonne of coke under the conditions of the trial. The slow operating speed of the coke plant reduced the effectiveness of energy recovery considerably. A more detailed technical-economic study leading to industrial development of the process is not planned.

40420 (EUR–11193) **Steam drying of beet pulp demonstration project.** Anon. Commission of the European Communities, Luxembourg (Luxembourg). 1987. 19p. Available from NTIS (US Sales Only), PC A03/MF A01.

The objective of the project is to develop a drying plant for beet pulp and other products, the drying of which can take place within a closed system with circulating overhead steam which keeps the material to be dried moving in a fluidized bed. Heat has to be induced into the system, and from this system steam can be drained to be utilized for other purposes. It is possible to save energy which cannot be achieved from a plant where the drying is carried out by hot air. In addition to the energy saving, the method will reduce the impact on the environment, and in comparison with other traditional methods of drying the product quality will be improved.

40421 (SJF-Orientering–56) **Air-air heat exchangers in sties for young swine.** Moeller, F. Statens Jordbrugstekniske Forsoeg, Horsens (Denmark). Afd. for Landbrugsbygniner. Jun 1988. 12p. (In Danish). Order Number DE89902324/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

It is important that the air in pigsties for very young pigs is kept at an even temperature. In order to conserve energy, control of the ventilation system is significant, but heat losses are very difficult to avoid. Air-air heat exchangers can provide the answer to this problem. Experiments were carried out where a heat exchanger and an electric heater were used to keep a constant temperature of 10 deg. C at the entry area of four pigsties, from where fresh air was taken in for all four sties. Energy consumption was measured both with and without a heat exchanger in operation. An average energy saving of 16kWh per day was registered when a heat exchanger was in use, and it was registered that 790 Danish kroner could be saved annually. In another complex of four pigsties, the energy consumption was measured in each sty, and it was reckoned that for all four sties, each containing 160 piglets, utilization of a heat exchanger from November to March, could save 5500kWh or about 1815 Danish kroner. (AB).

40422 (SNV–3491) **Research and development within waste and retrieval.** Pettersson, C. National Swedish Environmental Protection Board, Solna (Sweden). May 1988. 60p. (In Swedish). Order Number DE89902413/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Questions concerning industrial waste (retrieval-treatment) are among the most important questions to be solved in the next five years. In connection with a better taking care of industrial waste also development aiming at more waste saving technologies and more environment-positive waste products. Retrieval and more pro-environmental technologies i.e. conservation of resources are together a great and urgent field where coordinated R and D activities, within the country as well as abroad, should be encouraged. The aspiration of the industry to find new ways of increased internal retrieval, internal treatment, and of developing it's own production processes in order to decrease the quantities of anti-environmental waste that needs to be externally treated, should be given priority. But also the ultimate administration should be devoted great attention in the next five years. The R and D fields enumerated should be given highest priority but also strategies for deposition, different retrieval activities and systems analyses (incl. administration of waste) must be devoted great attention. A well working and built out R and D activeness will demand yearly contributions of MSEK 50-70.

40423 (STU–85-4925) **Effect of hot rolling lubrication in a pilot plant mill - Second experimental report.** Jarl, M.; Li Xiaoyu. Swedish National Board for Technical Development, Stockholm (Sweden); Foundation for Metallurgical Research, Luleaa (Sweden). 30 Sep 1988. 52p. (MEFOS-BTF–87044). Order Number DE89902434/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Experiments with hot rolling lubrication in a pilot plant rolling mill have been carried out at MEFOS (Foundation for metallurgical research) Metal Working Research Plant. The rolling was carried out as a controlled rolling in 930 deg C and 880 deg C and as a conventional rolling on Nb-alloyed steel billet which were flat rolled to 12 mm, 8 mm, 6 mm and 5 mm thickness. The influence of lubrication on the rolling force and torque in controlled rolling is smaller than that in conventional rolling, when the rolling product thickness is 5 mm and 6 mm. Around max. 20% rolling force decrease was achieved in conventional rolling. The effect of lubrication is related

to the L/H value, but due to the scale which was formed during the holding period in controlled rolling the effect of lubrication was decreased in controlled rolling. According to the results of the test, the economic benefit is analysed when using lubricant in controlled rolling and conventional rolling. The possibility of using hot rolling lubricant in controlled rolling in a weak rolling mill is also discussed.

40424 (STU–87-1687) **Natural gas fuelled drying in combination with electric power production.** Andersson, S.; Christensen, R. Swedish National Board for Technical Development, Stockholm (Sweden). 30 May 1988. 98p. (In Swedish). Order Number DE89902435/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report describes technological and economic bases for electric power generation with natural gas fuelled internal combustion engines and gas turbines in combination with drying processes. In addition the environmental impacts of machines and laying out were studied. The drying processes studied within the project were two dryers for direct firing at two industries with different conditions regarding operating time, drying data, supply of heat etc. The report shows the expected cost of electric power production for an installation in the different cases and what technological and economic conditions prevailing in this respect in these industries. The report points out a great number of technical and economic parameters to be studied to provide a true picture of the economic value of a gas engine or gas turbine installation.

3206 Municipalities and Community Systems

Refer also to citation(s) 40148, 40151, 40175, 40188, 40261, 40397

40425 (BFR-R–12-1989) **Lake water plant at Aare. Measurements and evaluation.** Holmlund, I. Swedish Council for Building Research, Stockholm (Sweden). 1989. 62p. (In Swedish). Order Number DE89902429/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The plant is composed of two heat pumps of 0.65 MW each, a 2.0 MW electric boiler, and a 2.9 MW oil-fired boiler. In the Aare lake two types of collectors have been placed. Collector 1 with a tube diameter of 110mm with a centre distance between tubes of 1 m has an inner tube with 50mm diameter put into the outer tube. Collector 2 is without inner tube and of 90mm diameter with a centre distance between tubes of 0.5m. In the collector system circulates a brine of 20% $CaCl_2$ solution. The division in 1986 between heat pumps, electric boiler and oil-fired boiler was 72/22/6 percent. The coefficient of performance, calculated as the ratio between the energy supplied to the district heating water and the electric energy supplied to the heat pumps were: 1985 Sep-Dec 2.04; 1986 Jan-Dec 1.94; 1987 Jan-Aug 1.87. The operation experience of the plant has been good during 1987/88. The heat pump technique with surface water, often cold water, as heat source is well established and it provides an environment-positive energy technology.

40426 (CONF-8906176–1) **Market penetration potential of new clean coal technologies.** Veselka, T.D.; Rose, K. Argonne National Lab., IL (USA). 1989. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From Utility opportunities for new generation; Boston, MA (USA); 28-30 Jun 1989. Order Number DE89015135/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The diverse nature of the electric utility sector, both in terms of supply and demand, will allow numerous new coal-burning technologies to find economic niches within the marketplace. The focus of this paper is on the potential market penetration rate for one clean coal technology, Integrated Gasifier Combined Cycles (IGCC), from 1995 to 2024. The market penetration of IGCC was examined in two power pools that are distinctly different in terms of electric supply and demand. These pools consist of groups of companies that aggregate their resources for dispatching or trading electricity to achieve operating economies through energy exchanges. The first pool is located in the Midwest and is part of the North American Electric Reliability Council's (NERC) East Central Area Reliability Coordination Agreement (ECAR) region. The second pool is the Florida subregion of NERC's Southeastern Electric Reliability Council (SERC) region. Emphasis is placed on how both the current technology configuration of the power pool and how future demand profiles influence the penetration rate of a new technology. The effects of fuel prices on technology penetration are also examined. The argonne Utility Simulation (ARGUS) model is used to estimate IGCC market penetration under various economic assumptions. 20 refs., 8 figs.

40427 (DOE/IR/05106–T112) **Commercialization of fluidized bed combustion systems in urban areas: The local government role.** Jacobs, L. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Apr 1983. 107p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015421/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of this project was two-fold: to review the critical technical and institutional considerations which must underlie any decision to invest in Fluidized-Bed Combustion technology and to gauge the market for FBC technology within the City of Indianapolis. To achieve these purposes extensive research into the state-of-the-art of FBC technology was performed, including a review of alternate design configurations and an assessment of the remaining technical and operational difficulties associated with this new technology. At the same time a number of key financing and regulatory issues were investigated which directly affect the marketability of FBC boilers to local industries and institutions. Some of the largest Indianapolis energy users were surveyed to determine their long-term thermal energy requirements and whether FBC technology could help to meet these requirements. On the basis of this survey data, a comparative cost-benefit analysis of investment in a FBC boiler compared with investment in other types of boilers was undertaken. The analysis was done for specific Indianapolis industries and institutions. This report summarizes the project activities and makes specific recommendations that should help to facilitate the commercialization of FBC boilers in Indianapolis.

40428 (EC–E40-11/3-1988, pp. 43-54) **Your lead-acid batteries. A negative charge to the environment.** McIver, B (Nova Pb Inc., Ville Ste-Catherine, PQ, Canada); Capowski, R. Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg (Canada), 25-27 Oct 1988; MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The lead-acid battery industry, automobile industry and lead industry in Canada are reviewed as background to an assessment of battery recycling. Since most batteries are used in cars, some trends in the automobile industry are outlined which affect the number of batteries being used, the volume of lead used in these batteries and some of the characteristics of the lead-acid batteries themselves. It is seen that motor vehicle registrations have been increasing, but the trend toward more fuel-efficient, lighter vehicles and improved battery designs has led to a decrease in average amount of lead per battery and a longer battery life. Automotive design trends affecting lead-acid batteries include fewer cylinders in cars, higher operating temperatures, and increasing use of electric devices needing battery power. Examination of data from Quebec reveals that only about 2/3 of batteries are currently recycled. An estimate of the total amount of lead in lead-acid batteries (including cars, trucks, locomotives, boats, and industrial uses) shows a total of over 446 million pounds. This could increase to over 500 million pounds by 1991 at current growth rates. The recycling efforts of Nova Pb, Canada's largest lead recycling installation, are then described. The plant has the capacity to produce over 50,000 metric tons of lead per year, which would be the amount of lead found in about 5.5 million batteries. A number of suggestions are made for improving recycling rates of lead-acid batteries. 3 refs., 5 tabs.

40429 (SNV–3493) **Methods of processing municipal waste.** Enhoerning, B. National Swedish Environmental Protection Board, Solna (Sweden). May 1988. 118p. (In Swedish). Order Number DE89902412/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The present processing procedures are described. The ideal method would be one where the waste was sorted and retrieved to 100%. This is not possible because: - the waste is not unambiguous from sorting point of view, - some types of waste are unsortable, - waste producers neither can nor want to sort the waste provided it does not save their own interests, - nobody will pay enough for most of the material that would be possible to sort out. Thus it is unrealistic to look upon retrieval as anything but a partial effort were a possible decrease of total waste quantity would be maximally 20%. Composting, combustion and pyrolysis are the processes discussed in the report. (With 55 refs.).

40430 (STEV–1988-R13) **IEA District Heating. State-of-the-art review of coal combustors for small district heating plants.** Statens Energiverk, Stockholm (Sweden). 1988. 83p. Order Number DE89902384/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The most important types of conventional firing systems for small district heating plants are chain-grate stokers and vibrating-grate stokers. Fluidized combustion is fairly well developed for small heating boilers, but it is not yet fully proven through widespread operating experience. It has the best overall potential of all the firing systems for application to small district heating plants, and it is of special interest for firing low-grade coal or coal waste where these are available as low-cost fuel. The primary areas where additional research and development would be beneficial to coal-fired heating plants are: fuel handling; flyash recycle; ash handling; and automatic operation. Further development work should be especially helpful for FBC boiler systems, particularly for solid handling systems for low-grade coal and coal waste. The general potential for the increased use of small coal-fired plants in district heating was fairly good in 1985, but it was significantly reduced by the decrease in fuel oil and natural gas prices in 1986. OPEC and some other oil-exporting countries are trying to bring about higher oil prices by reducing production, however, and it would not be unlikely that oil prices will increase to some extent in the foreseeable future.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

40431 (ETDE-mf–9794876) **Definition phase - PROMETHEUS. Part project: Volkswagen. Final report.** Grove, H.W. Volkswagenwerk A.G., Wolfsburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 30 Apr 1988. 36p. (In German). Contract BMFT TV 8627D0;BMFT TV 8727D8. Order Number DE89794876/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A02/MF A01.

Tasks and goals of the project PROMETHEUS are described. The project structure is explained and the Volkswagen participation in the project is stated. As results of the definition phase the project work Volkswagen will be working on in the future time of the project is thoroughly outlined. (orig.) With 8 figs.

3301 Internal Combustion Engines

Refer also to citation(s) 39904, 40169, 40170, 40173, 40616

40432 (NAL–TR-969) **Experiment on a cylindrical scramjet combustor (II). Simulated flight Mach number 6.7.** Komuro, Tomoyuki; Murakami, Atsuo; Kudo, Kenji; Matsuya, Goro; Chinzei, Nobuo. National Aerospace Lab., Chofu, Tokyo (Japan). Mar 1988. 18p. (In Japanese). Order Number DE89772311/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from National Aerospace Laboratory. 7-44-1, Jindaiji-higashimachi, Chofu-shi, Tokyo.

An experiment was made on cylindrical scramjet (supersonic ramjet) combustor. It simulated the flight Mach number 6.7 using high temperature simulated air of 2,000K and 1.0MPa. Spontaneous ignition of fuel hydrogen occurred at 1410-1560K (equivalent to Mach number 5.6-5.9). The flame holding position moves downstream when the flow rate and dynamic pressure of jet are low. The degree of mixing increase more slowly by the supersonic combustion than subsonic combustion. Proportion of fuel components is high near the wall and low at the center. Two types of fuel injection were tested: Vertical injection at up- and downstream and parallel injection. The mixing efficiency is highest with the parallel injection, whereas the combustion efficiency was almost equal to each other. The ratio of dynamic pressures of the air to fuel affected the mixing only immediately downstream of injector. The fuel mixing was not affected by he Mach number in the supersonic flight. Parallel injection was needed with the low flight Mach number, where a problem on the transition to subsonic mode was posed by rapid heat generation immediately after the injection. Results of the one-dimensional analysis agreed with experiments. 22 references, 22 figures, 2 tables.

3303 Electric-powered Systems

Refer also to citation(s) 40323

3307 Emission Control

Refer also to citation(s) 39904

3308 Alternative Fuels

40433 (ORNL/TM–11229) **Results from the first year of operation of the Federal Methanol Fleet at Oak Ridge National Laboratory.** McGill, R.N.; West, B.H.; Hillis, S.L.; Hodgson, J.W. Oak Ridge National Lab., TN (USA). [1989]. 23p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89014345/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Oak Ridge National Laboratory has completed over one full year of operation of ten vehicles for the Federal Methanol fleet Project; five of the vehicles are fueled with methanol. Nearly 100,000 miles were accumulated on the vehicles in a nearly trouble-free operation during the first year. Energy consumption for the methanol cars was slightly higher than for the gasoline cars, most likely as a result of shorter average trip lengths for the methanol cars. Iron and lead have accumulated at a greater rate in the lubricating oil of the methanol cars. Drivers ratings of vehicles reflected some dissatisfaction with the cold-weather performance of the methanol cars, but the cars have no special provisions for cold weather. Otherwise, drivers' ratings have been very similar between methanol and gasoline cars. 10 refs., 4 figs., 5 tabs.

35 ARMS CONTROL

Refer also to citation(s) 40853, 40854

3503 Verification

Refer also to citation(s) 40855

40434 (UCRL–100996) **Quantifying ambiguity surrounding subjective probabilities.** Strait, R.S.; Morris, P.A. Lawrence Livermore National Lab., CA (USA). 5 May 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890563–2: CORS/TIMS/ORSA joint national meeting, Vancouver (Canada), 8-10 May 1989). Order Number DE89015724/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Ambiguity is a measure of the level of discomfort one feels about the accuracy of the probability of an uncertain event; ambiguity is separate from the uncertainty itself. Our research has developed techniques that extend decision theory so that ambiguity surrounding subjective probabilities can be assessed and analyzed logically and consistently. We have constructed an improved theoretical foundation for ambiguity assessments. Using this foundation, we have developed a hierarchy of three techniques for assessing ambiguity surrounding subjective probabilities. In the future we will apply these results to treaty verification decisions in order to assess more completely the implications of ambiguity. 9 refs., 3 figs.

36 MATERIALS

40435 (ANL–89/3, pp. 4-8) **Process of processing: how to commercialize it all.** Frey, D.N. (Northwestern Univ., Evanston, IL (USA)). Argonne National Lab., IL (USA). Feb 1989. (CONF-8806303–: Conference on advanced materials in the manufacturing revolution, Argonne, IL (USA), 14 Jun 1988). In *Advanced materials in the manufacturing revolution. Proceedings.* Order Number DE89008190/JAW. Available from NTIS, PC A05/MF A01.

The author points out we are relearning that, for any country, the driving economic force is the ability to innovate; all the rest, he notes, is care taking - maintaining the capital base, which provides no growth or competitiveness. He treats three topics that appear central to the theme of the conference: (1) the manufacturing revolution and how it started; (2) the role of advanced materials; and (3) the technology transfer relationship. He feels advanced materials will have a large impact to the extent they affect the major driving force noted above - innovation. He says we must tackle the as-yet-unsolved technology transfer problem, and we must break away from obsolete manufacturing concepts and methods that have hobbled us in the past.

40436 (ANL–89/3, pp. 17-26) **Exploiting new materials for competitive advantage.** Bement, A.L. Jr. (TRW, Inc., Cleveland, OH (USA)). Argonne National Lab., IL (USA). Feb 1989. (CONF-8806303–: Conference on advanced materials in the manufacturing revolution, Argonne, IL (USA), 14 Jun 1988). In *Advanced materials in the manufacturing revolution. Proceedings.* Order Number DE89008190/JAW. Available from NTIS, PC A05/MF A01.

In this discussion, the author focuses on the following major themes: the changing global scene; industry responses; emerging materials technologies; opportunities for new materials in design and production; managing the technology selection and acquisition process; and lessons learned. He concludes that the U. S. industrial enterprise, its ability to innovate, and its enormously strong national research infrastructure can provide us with the major weapons we need for future global competition. Further, the growing interest of universities and national laboratories in establishing closer relationships with industry gives us every reason to expect that the United States can be a major technological force in global markets well into the future. The critical element, however, is learning better how to leverage these technical resources to our best advantage.

40437 (ANL–89/3, pp. 64-70) **Manufacturing flexibility for competitive advantage ... the strategic imperative for CIM.** Goldhar, J.D. (Illinois Institute of Technology, Chicago (USA)). Argonne National Lab., IL (USA). Feb 1989. (CONF-8806303–: Conference on advanced materials in the manufacturing revolution, Argonne, IL (USA), 14 Jun 1988). In *Advanced materials in the manufacturing revolution. Proceedings.* Order Number DE89008190/JAW. Available from NTIS, PC A05/MF A01.

Other papers in these proceedings stressed innovation and the role of materials, the flexible integration of product and process, and the coupling of materials design, engineering, and manufacturing. Professor Goldhar points out how modern information and control technologies, particularly computer-integrated manufacturing (CIM), permit these new thrusts to be dealt with and exploited on the factory floor. After an introductory section, other sections are included on: (1) understanding CIM; (2) economy of scope, factory operations, and the new meaning of productivity; (3) strategies for maximizing value in CIM-based businesses; and (4) implementation. 3 references, 1 figure.

40438 Engineered materials for advanced friction and wear applications; Proceedings of the International Conference, Gaithersburg, MD, Mar. 1-3, 1988. Smidt, F.A.; Blau, P.J. 270p. ASM International, Metals Park, OH (1988). (CONF-880317–: ASM symposium on engineered materials for advanced friction and applications, Gaithersburg, MD (USA), 1-3 Mar 1988).

Recent advances in the preparation, evaluation, and application of wear-resistant materials are discussed in reviews and reports. Topics addressed include friction and wear mechanisms in engineered materials, advanced materials and surface treatments for friction/wear applications, lubrication of engineered materials, aerospace and defense applications, and computer and electronics applications. Consideration is given to atomic-scale friction measurements using an atomic force microscope, the effect of transfer films on the wear of ceramic materials, flash-temperature computations, wear of composition-modulated Ni-Cu alloys, tribology in manufacturing, the abrasive wear resistance of TiC/ferrous-matrix particulate composites, autocatalytic deposition of MMCs, lamellar liquid crystals, tribology problems in future spacecraft, surface contact resistance in electrical connectors, and a computerized tribology information system.

3601 Metals and Alloys

Refer also to citation(s) 39917, 39921, 39935, 39938, 39941, 39971, 39972, 40020, 40133, 40205, 40235, 40493, 40597, 40671, 40691, 40725, 40826, 40828, 41356

40439 (ANL–89/3, pp. 27-36) **Assessment of new engineered metallic materials.** Williams, J.C. (General Electric Company, Cincinnati, OH (USA)); Nevitt, M.V. Argonne National Lab., IL (USA). Feb 1989. (CONF-8806303–: Conference on advanced materials in the manufacturing revolution, Argonne, IL (USA), 14 Jun 1988). In *Advanced materials in the manufacturing revolution. Proceedings.* Order Number DE89008190/JAW. Available from NTIS, PC A05/MF A01.

This paper provides a perspective on a group of metallic materials that are considered new because they are not yet in wide use, and engineered in the sense that they have unique performance characteristics imparted by value-adding steps taken during production. Emphasis is placed on the intimate association of properties, processing, and design, and their coupled influence on the manufacture of metallic products and components that can be attractive in world markets. Tailoring materials to specific applications holds one of the most important keys to competitiveness, and a critical step lies in producing a confluence of design and manufacturing, the authors feel. After providing a general definition of an engineered material, they develop a generic model of such a material. Following that, the close coupling to processing methods is shown, and several examples were cited. They then treat the complementary design issue. Throughout the discussion and in summary fashion at the end, they describe several particularly important and promising new engineered metallic materials. 3 figures, 3 tables.

40440 (BNL–43032) **Structure analysis of NiAl martensite.** Noda, Y.; Shapiro, S.M.; Shirane, G.; Yamada, Y.; Fuchizaki, K.; Tanner, L.E. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8907114–1: International conference on martensitic phase transformations (ICOMAT-89), Sydney (Australia), 3-7 Jul 1989). Order Number DE89015100/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Neutron elastic scattering experiments were performed in order to investigate the structure of the low temperature martensitic phase of $Ni_{62.5}Al_{37.5}$ alloy. The average structure analyzed from the integrated intensity was approximately described by the (5,–2) structure proposed by Martynov et al. Small deviation from the exact (5,–2) model in the positional parameters and the anomalously large Debye-Waller factor were obtained. The observed satellite profiles show asymmetrical broadening, and the peak positions shift from the regular reciprocal lattice points. These anomalous features of scattering profiles were tentatively interpreted by introducing spatial modulation of the strain and order parameters. 12 refs., 2 figs., 1 tab.

40441 (CEA-CONF–9752) **Buckling under time depending loads.** Combescure, A. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 13p. (CONF-8811187–: Seminar on recent advances in design procedures for high temperature plant, Risley (UK), 8-9 Nov 1988). Order Number DE89903181/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The aim of the paper is to present some methods to prevent buckling under time dependent loadings. Two methods are given: one for very long time loads (creep buckling) and an other one for transient loadings coming from a seismic event.

40442 (CEA-CONF–9788) **Effect of residual stresses on fatigue crack propagation at room temperature in a ferritic-austenitic welded joint.** Zahouane, A.I.; Gauthier, J.P.; Marini, B. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie. 1988. 7p. (CONF-8809377–: 7. European conference on fracture (ECF), Budapest (Hungary), 19-24 Sep 1988). Order Number DE89903281/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Dissimilar ferritic-austenitic welded joints present in several nuclear reactor components are frequently subjected to fatigue. In this context we have measured the fatigue crack growth rate in a ferritic-austenitic welded plate using compact tension specimens. The most significant observation made is an important decrease of the crack propagation rate, linked to a high level of crack closure when cracks reach the ferritic-austenitic boundary. The reason for this is shown to be the presence of high residual stresses produced during the welding operation. Measurement of these stresses are made using a hole drilling method modified to allow determination of non-uniform stress fields. This method is based on the existence of a special function called transmissibility function. From the stress measurement results, first the residual stress intensity factors are derived using a weight function method and then a quantitative crack propagation analysis is performed. The results obtained give a satisfactory explanation to the observed decrease in the crack propagation rate and the crack closure phenomenon.

40443 (CONF-890426–24) **Damage growth in Si during self-ion irradiation: A study of ion effects over an extended energy range.** Holland, O.W.; El-Ghor, M.K.; White, C.W. Oak Ridge National Lab., TN (USA). [1989]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Diego, CA (USA); 24-28 Apr 1989. Order Number DE89015044/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Damage nucleation/growth in single-crystal Si during ion irradiation is discussed. For MeV ions, the rate of growth as well as the damage morphology are shown to vary widely along the track of the ion. This is attributed to a change in the dominant, defect-related reactions as the ion penetrates the crystal. The nature of these reactions were elucidated by studying the interaction of MeV ions with different types of defects. The defects were introduced into the Si crystal prior to high-energy irradiation by self-ion implantation at a medium energy (100 keV). Varied damage morphologies were produced by implanting different ion fluences. Electron microscopy and ion-channeling measurements, in conjunction with annealing studies, were used to characterize the damage. Subtle changes in the predamage morphology are shown to result in markedly different responses to the high-energy irradiation, ranging from complete annealing of the damage to rapid growth. These divergent responses occur over a narrow range of dose ($2–3 \times 10^{14}$ cm^{-2}) of the medium-energy ions; this range also marks a transition in the growth behavior of the damage during the predamage implantation. A model is proposed which accounts for these observations and provides insight into ion-induced growth of amorphous layers in Si and the role of the amorphous/crystalline interface in this process. 15 refs, 9 figs.

40444 (DOE/ER/45281–3) **Investigation of magnetic anisotropy and spin wave modes in transition metal multilayers: Technical progress report, August 1988–July 1989.** Pechan, M.J. Miami Univ., Oxford, OH (USA). 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER45281. Order Number DE89015016/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The magnetic properties of compositionally modulated structures known as superlattices or multilayers are of considerable interest because of their application to magnetic recording technology and because of the insight provided into the fundamental nature of magnetism. Anisotropic properties are of vital import in developing stable, well defined, high density magnetic domains in both flux and optically detected magnetic recording media. Spin wave investigations, on the other hand, provide insight into the fundamental nature of surface spin states and interior spin dynamics. Measurements in CuNi and MoNi indicate a very large degree of magnetic anisotropy, which seems to be frequency dependent. The sources of the anisotropy have not been fully explained and the reason for the frequency dependence remains unknown. The FMR measurements on these systems all show definite structure in the perpendicular spectra, but spin wave analysis of this structure has not been reported. It is reasonable to assume that the source of the anisotropy, its frequency dependence and the perpendicular FMR structure are intimately related. Funds are sought to continue the investigation of MoNi multilayers by measuring the frequency and temperature dependence of the anisotropy and by measuring the frequency dependence of the peculiar perpendicular FMR structure. The studies are being extended to the VNi multilayers, so that the importance of nonmagnetic type may be examined. 21 refs., 3 figs.

40445 (DOE/OR/00033–T429) **Oak Ridge Synchrotron Organization for Advanced Research (ORSOAR): Annual report, 1 October 1987–30 September 1988.** Peters, C.J.; Sparks, C.J. Oak Ridge Associated Universities, Inc., TN (USA); Oak Ridge National Lab., TN (USA). 1988. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-76OR00033;AC05-84OR21400. Order Number DE89015494/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report briefly describes the research highlights, publications, and work in progress for the Oak Ridge Synchrotron Organization for Advanced Research. Among the research highlights of this reporting period are the following: We have advanced the technique for depth-profiling strain distributions in materials. We continued our studies of depth-profiling of polished and severely grounded, fully stabilized zirconia using long wavelength x-rays and shallow glancing angles, strain gradients near the surface approached maximum compressive strains of 4% but dropped rapidly as a function of depth. Strain profiles in thin (~900A°) films of GaAs grown on Si(001) substrates have shown that about 90% of the strain from lattice mismatch is dissipated in a few GaAs planes (~10A°) at the silicon interface. The other 10% of the strain is distributed uniformly throughout the bulk of the GaAs film. An exciting discovery of a huge x-ray magnetic resonance scattering effect in UAs that was larger than expected opens the door for mapping the magnetic structure of materials by tuning the x-ray energy near an absorption edge.

40446 (EPRI-GS–6441-Vol.1) **Service embrittlement of gas turbine blade alloys Udimet 710 and IN-738: Volume 1, Test results and analysis: Final report.** Pard, A.G. Electric Power Research Inst., Palo Alto, CA (USA); Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div. c Jul 1989. 75p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A study was performed to determine the effect of aging on impact toughness and microstructure of turbine blade superalloys Udimet 710 (U-710) and IN-738 (high carbon version). It was found that for the standard heat treatment and varying aging conditions, [1000, 5000 and 10,000 h at 790°C (1454°F), 830°C (1526°F) and 900°C (1652°F)], the cast alloy IN-738 suffers no loss of impact toughness. On the other hand, the impact properties of heat-treated wrought U-710 are moderately degraded for aging times up to 5000 h at 790°C (1454°F) and severely degraded for aging times of 1000 h and greater at temperatures at and above 830°C (1526°F). Energy dispersive x-ray analysis and x-ray mapping show the grain boundary phase after aging in both alloys to be chromium carbide of the $M_{23}C_6$ stoichiometry most probable. The difference in grain structure, convoluted for IN-738 as compared to equiaxed for U-710, appears to be the major microstructural difference and probable reason why IN-738 maintains comparatively better impact toughness – about twice as high – after long-time aging. An atlas of microstructural change with aging was prepared for both materials for use in assessing the degree of embrittlement that has taken place in service run blades and is issued as an addendum to this report. A procedure for monitoring service run blades by taking replicas of the aged microstructure of blades without removing them from the turbine is also described. 8 refs., 40 figs., 19 tabs.

40447 (EPRI-GS–6441-Vol.2) **Service embrittlement of gas turbine blade alloys Udimet 710 and IN-738: Volume 2, Atlas of micrographs and impact toughness: Final report.** Pard, A.G. Electric Power Research Inst., Palo Alto, CA (USA); Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div. c Jul

1989. 66p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report is issued as an addendum to the main report on the effect of aging on impact toughness and microstructure of turbine blade superalloys Udimet 710 (U-710) and IN-738 (high carbon version). In this study, it was found that for the standard heat treatment and varying aging conditions, [1000, 5000, and 10,000 h at 790°C (1454°F), 830°C (1526°F) and 900°C (1652°F)], the cast alloy IN-738 suffers no loss of impact toughness. On the other hand, the impact properties of heat-treated wrought U-710 moderately degraded for aging times up to 5000 h at 790° C (1454°F) and severely degraded for aging times of 1000 h and greater at temperatures at and above 830°C (1526°F). In this addendum, an Atlas of photomicrographs showing the detailed evolution of microstructure with aging is presented for both materials. The Atlas may be used to assess the degree of embrittlement that has taken place in service-run blades by comparing the aged microstructure of the blade with those in the Atlas and corresponding impact toughness values, which are repeated in this addendum for easy reference. 44 figs., 9 tabs.

40448 (EPRI-GS–6449) **Laboratory coal ash corrosion tests.** Wolowodiuk, W. Electric Power Research Inst., Palo Alto, CA (USA); Foster Wheeler Development Corp., Livingston, NJ (USA). c Jul 1989. 95p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In a program to provide complete, reliable corrosion data for selected superheater and reheater tube alloys, Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan, conducted materials tests in simulated coal-ash environments. Test coupons were made from 11 base alloys, 7 cladding alloys (typically for coextruded tubes), chromizings, plasma spray coatings, and weld metals. The coupons were coated with synthetic ashes mirroring actual deposits and were exposed to synthetic gas containing sulfur dioxide, oxygen, carbon dioxide, water, and nitrogen. They were exposed for 100 hours at 600 to 750°C (1112 to 1382°F) and then were weighed to determine metal loss. Based on the results of testing, three commercial alloys (Alloy 800H, HR3C, and Tempaloy CR30A) as single-walled tubes and Type 310SS and 35Cr-45Ni as clad or co-extruded tubes are recommended for aggressive, corrosive atmospheres. However, co-extruded tubes are expensive; thus there is an economic advantage to using HR3C and Alloy 800H in the corrosive atmospheres encountered in Phases 0 and 1. Materials are discussed for these advanced boilers as well as for boilers currently experiencing coal-ash corrosion.

40449 (FRNC-TH–3460) **Mechanical characterization of superalloys for space reactors.** Duchesne, J. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees; Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France). 1989. 169p. (In French). Order Number DE89903269/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The aim of this work is the selection of structural materials that can be used in the temperature range 600-900^{0}C for a gas cooled space reactor producing electricity. Superalloys fit best the temperature range required. Five nickel base alloys are chosen for their good mechanical behaviour: HAYNES 230, HASTELLOY S, HASTELLOY X, HASTELLOY XR and PYRAD 38D. Metallography, tensile and hardness tests are realized. Sample contraction is evidenced for some creep tests, under low stress: 20MPa at 800^{0}C, on HAYNES 230 and HASTELLOY X, probably related to the structural evolution of these materials corresponding to a decrease of the crystal parameter.

40450 (GKSS–88/E/63) **Neutron diffraction determination of texture development.** Boecker, W.; Brokmeier, H.G.; Bunge, H.J. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1988. 7p. (CONF-8709172–: 8. international conference on textures of materials (ICOTOM-8), Santa Fe, NM (USA), 20-25 Sep 1987). Order Number DE89795114/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Special print from: Kallend, J.S.; Gottstein, G. (eds.): 'Eighth international conference on texture of materials (ICOTOM 8)'; The Metallurgical Society, Warrendale, PA (USA), 1988, p. 959-964.

Texture measurements by neutron diffraction in two-phase alloys are free of the effect of anisotropic absorption encountered in X-ray diffraction in such materials. Because of the large sample sizes which can be used in this method, textures in phases of small volume components can be sufficiently measured (e.g. 1 Vol% or less). Using this method, the textures of extruded Pb-Al and Al-Cu in-situ composites were studied in the whole composition range. With the same external deformation degree, the internal deformation degree of a harder phase is the smaller the lower the percentage of this phase in a soft matrix. The internal deformation degree was determined by quantitative SEM measurements of the size of the harder particles. The external deformation is axially symmetric, not so, however, the internal deformation of the single phases. Hence, texture development in two phases is to be considered as a function of the internal deformation degree, but it also depends on the inhomogenity of plastic flow in the two phase material. (orig.).

40451 (INIS-BR–1554) **Spectral distribution of Fe^{2+} photoionization cross section in InP:Fe.** Iikawa, F. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. 1985. 61p. (In Portuguese). Order Number DE89632792/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Measurements of Fe^{2+} (^{5}E) photoionization cross section in InP at 80^{0}K, using constant current photoconductivity technique, were done. The spectrum presents a threshold energy of $\sim$ 0,65 eV due to the transition from Fe^{2+} charge state, in the ground state, to Fe^{3+} with an electron emission for the minimum conduction band. In the measurement of photoluminescence at $\sim$ 2^{0}K, a wide emission of Fe complexe with the strong lattice interaction. In order to analyse the experimental data of Fe^{2+} cross section in InP, a theoretical model was used. (M.C.K.).

40452 (INIS-BR–1557) **Submerged arc narrow gap welding of the steel DIN 20MnMoNi55.** Moraes, M.M. Universidade Federal, Rio de Janeiro, RJ (Brazil). 1987. 127p. (In Portuguese). Order Number DE89632726/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The methodology for submerged arc narrow gap welding for high thickness rolled steel DIN 20MnMoNi55 was developed, using din S3NiMo1 04 mm and 05 mm wires, and DIN 8B435 flux. For this purpose, submerged arc narrow gap welded joints with 50 mm and 120 mm thickness were made aiming the welding parameters optimization and the study of the influence of welding voltage, wire diameter and wire to groove face distance on the operational performance and on the welded joint quality, specially on the ISO-V impact toughness. These welded joints were checked by nondestructive mechanical and metallographic tests. Results were compared with those obtained by one 120 mm thickness submerged arc conventional gap welded joint, using the same base metal and consumables (05 mm wire). The analysis of the results shows that the increasing of the wire to groove face distance and the welding voltage increases the hardness and the ISO-V impact toughness of the weld metal. It shows that the reduction of the gap angle is the main cause for the obtained of a heat affected zone free from coarse grains, the reduction of the welding voltage, the increasing of the wire to groove face distance, and the grounding optimization also contribute for that. It was also concluded that the quality and the execution complexity level of a narrow gap welded joint are identical to a conventional gap welded joint. (author).

40453 (INIS-mf–11471, pp. 5) **Contamination of the topotactic and epitactic corrosion product deposit of the X8CrNiTi18.10 steel.** Schlenkrich, H. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Kelm, H.; Nebel, D. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden (German Democratic Republic), 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'*. Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

CORROSION PRODUCTS/contamination; STEEL-CR18NI10TI/corrosion products; AUTOCLAVES; BORIC ACID; CONTAMINATION; EPITAXY; FISSION PRODUCT RELEASE; OXIDATION; PH VALUE; SOLUTIONS; STEEL-CR18NI10TI

40454 (INIS-mf–11988) **Development and testing of methods for experimental determination of the fracture-mechanical characteristics of brittle fracture in component-type test pieces.** Technisch-wissenschaftliche Berichte der Staatlichen Materialpruefungsanstalt, Universitaet Stuttgart. Eisele, U. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1988. 251p. (In German). Contract BMFT 1500304A. Order Number DE89794808/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

From the viewpoint of the usability of the fracture-mechanical toughness parameters J-integral and crack tip opening displacement CTOD in the analysis of superficially cracked components of any geometry, the transferability of these parameters, determined on usual laboratory samples, was investigated for specimen configurations similar to construction components. The experimental investigations were carried out on the pressure container material 22 NiMoCr 3 7 with a notched bar impact in a toughness range of 90 J. (orig./MM).

40455 (INIS-SU–88, pp. 35-41) **Influence of stress on the development of helium bubbles in the steel 12Kh18N10T at ion bombardment.** Kalin, B.A. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (USSR)); Korshunov, S.N.; Yakushin, V.D.; Chernov, I.I.; Reutov, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation damages and radiation science of materials. Scientific-technical collection.* Order Number DE89012190/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(42).

The results of electron-microscopic study of the effect of external tensile stresses of 0...180MPa on the development of gas porosity in the near-the-surface layer of the 12Kh18N10T steel samples irradiated by He^+ ions with the energy of 40 keV at the constant temperature of 570K and under thermocycling 470reversible670K, are presented. It is found that the increase of external stresses brings about the increase in the bubble dimensions and near-the-surface layer swelling, the largest pores being observed in the layer adjoining the surface. Under the same irradiation conditions but at σ=0, bubbles at all distances from the surface have approximately the same diameter. 15 refs.; 7 figs.

40456 (INIS-SU–88, pp. 42-45) **Ion-induced desorption from aluminium and structural stainless steel surfaces.** Pistryak, S.V. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Morozov, A.N.; Rybalko, V.F.; Khazan, S.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation damages and radiation science of materials. Scientific-technical collection.* Order Number DE89012190/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(42).

Ion-induced desorption (IID) from the surface of stainless steels Kh16N15M3B, Kh18N10T and Al is studied. It is shown that hydrogen and CO_2 are the main desorbing components during target bombardment with H^+,H_2^+,He^+,O^+,O_2^+,Ar ion beams. The value of IID yields depends on sample prehistory and vacuum conditions (composition and value of partial pressure of residual gases). CO_2 yield from Al surface does not depend on the energy in the 6...20 keV energy range and grows with the mass of the bombarding particle (for ions of chemically active gases). CO_2 is generated directly on the irradiated surface from other components of the residual gas. 3 refs.; 3 figs.; 1 tab.

40457 (INIS-SU–89, pp. 185) **Synthesis and physicochemical studies of Li-B alloys.** Ivanov, A.S. (Saratovskij Gosudarstvennyj Univ., Saratov (USSR). Nauchno-Issledovatel'skij Inst. Khimii); Volgin, M.A.; Polikarpova, M.R.; Denisov, L.N. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

BORON ALLOYS/ductility; BORON ALLOYS/phase studies; LITHIUM BASE ALLOYS/ductility; LITHIUM BASE ALLOYS/phase studies; DUCTILITY; DIFFERENTIAL THERMAL ANALYSIS; PHASE TRANSFORMATIONS

40458 (INIS-SU–95, pp. 41-43) **Study of argon purity effect on accuracy of experiments on investigation into tungsten electrode resistance.** Shchavelev, L.N.; Butylkin, B.B.; Prokhorova, L.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). In *Welding in nuclear technology. Scientific-technical collection.* Order Number DE89012167/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 1(20).

Results of investigating the effect of protective atmosphere purity on tungsten electrode resistance are presented. Experiments are described and obtained dependences are presented. Recommendations on improving accuracy of experiments and increasing tungsten electrode resistance during welding are given. 7 refs.; 2 figs.

40459 (INIS-SU–95, pp. 28-31) **Residual stresses in explosion welded titanium-steel joints.** Trykov, Yu.P.; Pokataev, E.P.; Gul'bin, V.N.; Nikolaev, V.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). In *Welding in nuclear technology. Scientific-technical collection.* Order Number DE89012167/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 1(20).

Results of investigation of residual stresses in bimetallic and multi-layer titanium-steel joints are presented. The decisive role of thermoplastic strains, determined by W_2 energy (energy, expended on plastic strain under explosion welding), in formation of residual stresses in bimetals, was shown theoretically and supported by experiments. It was established that high tempering promoted redistribution of residual stresses in joints of heterogeneous materials according to different coefficients of linear expansion of welded metals. 9 refs.; 5 figs.; 1 tab.

40460 (INIS-SU–95, pp. 8-10) **Study of 12Kh18N10T steel structure effect on pitting corrosion of welded joints.** Agapov, G.I.; Komissarov, V.G.; Roshchin, V.V.; Kuranov, V.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). In *Welding in nuclear technology. Scientific-technical collection.* Order Number DE89012167/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 1(20).

Results of investigating structure effect on pitting corrosion of 12Kh18N10T steel and its welded joint in iron chloride solution are presented. It is shown that structural heterogeneity of the steel stimulates the development of this type of local corrosion. 6 refs.

40461 (INIS-SU–98, pp. 107) **Amorphization effect in Fe-Ni crystalline foils under phosphorus ion bombardment.** Gol'tsev, V.P.; Drako, V.M.; Uglov, V.V.; Sukie, M.; Khodasevich, V.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

IRON BASE ALLOYS/amorphous state; IRON BASE ALLOYS/physical radiation effects; ANNEALING; CRYSTAL-PHASE TRANSFORMATIONS; DOSE-RESPONSE RELATIONSHIPS; FOILS; ION IMPLANTATION; NICKEL ALLOYS; PHOSPHORUS IONS

40462 (INIS-SU–98, pp. 109) **Role of mechanical stresses induced by ion implantation in stainless steel phase transformations.** Jensen, E.; Johansen, A.; Sarholt-Kristensen, L.; Chechenin, N.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

STAINLESS STEELS/crystal-phase transformations; STAINLESS STEELS/physical radiation effects; BCC LATTICES; DOSE-RESPONSE RELATIONSHIPS; FCC LATTICES; HELIUM IONS; KEV RANGE 100-1000; MEV RANGE 01-10; STRESSES; SURFACES

40463 (INIS-SU–98, pp. 110) **Topographical and concentrational effects under high dose ion implantation in copper single crystals.** Johansen, A.; Jonson, E.; Sarholt-Kristensen, L.; Chernysh, V.S.; Chechenin, N.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

COPPER/physical radiation effects; COPPER/surfaces; BLISTERS; CESIUM IONS; COPPER; SURFACES; ION IMPLANTATION; KEV RANGE 100-1000; LEAD IONS; MONOCRYSTALS; RADIATION DOSES; TIN IONS; XENON IONS

40464 (INIS-SU–98, pp. 111) **Structure of metastable alloys produced by ion implantation and ion beam mixing.** Nevolin, V.N.; Fominskij, V.Yu.; Kulikauskas, V.S.; Petrikin, Yu.V.; Isaenkov, V.G.; Markeev, A.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

CHROMIUM BASE ALLOYS/microstructure; CHROMIUM BASE ALLOYS/physical radiation effects; COPPER BASE ALLOYS/microstructure; COPPER BASE ALLOYS/physical radiation effects; BINARY ALLOY SYSTEMS; CHEMICAL COMPOSITION; MICROSTRUCTURE; ION IMPLANTATION; IRON ALLOYS; MIXING; THERMODYNAMIC PROPERTIES; TIN ALLOYS

40465 (INIS-SU–98, pp. 120) **Antimony implantation effect on aluminium mechanical properties.** Gol'tsev, V.P.; Zhukova, S.I.; Sejkhas, Eh. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ALUMINIUM/creep; ALUMINIUM/ion implantation; ALUMINIUM; CREEP; ANTIMONY IONS; BENDING; DOSE-RESPONSE RELATIONSHIPS; KEV RANGE 10-100; MICROHARDNESS; PHYSICAL RADIATION EFFECTS

40466 (INIS-SU–98, pp. 123) **Study of surface composition of ion-doped steel by rutherford backscattering method.** Tashlykov, I.S.; Kolotyrkin, V.I.; Pil'ko, V.V.; Kulikauskas, V.S.; Poplavskij, V.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

CARBON STEELS/chemical composition; CARBON STEELS/ion implantation; CHROMIUM IONS; CORROSION RESISTANCE; KEV RANGE 01-10; SILICON IONS; SURFACES

40467 (INIS-SU–98, pp. 130) **Structure and composition of layers manufactured by Ti^+ implantation into Si.** Petukhov, V.Yu.; Khajbullin, I.B.; Gretchel, R. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; SILICON/phase studies; AMORPHOUS STATE; CRYSTALLIZATION; HEAT TREATMENTS; KEV RANGE 10-100; MONOCRYSTALS; SILICON; SURFACES; TITANIUM IONS

40468 (INIS-SU–98, pp. 131) **Strength, structure and phase composition of aluminium films after nitrogen ion implantation.** Fajzrakhmanov, I.A.; Funk, L.A.; Khajbullin, I.B.; Strezhnev, S.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ALUMINIUM/ion implantation; ALUMINIUM; DOSE-RESPONSE RELATIONSHIPS; FILMS; HARDENING; MICROHARDNESS; NITROGEN IONS; PHASE STUDIES; SWELLING

40469 (INIS-SU–98, pp. 144) **Microhardness changes on irradiated and opposite sides of permalloy foils after ion implantation.** Pavlov, P.V.; Tetel'baum, D.I.; Kuril'chik, E.V.; Romanov, I.G.; Pavlov, A.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

PERMALLOY/ion implantation; PERMALLOY/microhardness; ARGON IONS; BORON IONS; CARBON IONS; DOSE-RESPONSE RELATIONSHIPS; FOILS; KEV RANGE 10-100; NITROGEN IONS; PERMALLOY; MICROHARDNESS; PHOSPHORUS IONS

40470 (INIS-SU–98, pp. 145) **Dislocations role in longrange effect manifestation in silicon under ion bombardment.** Perevoshchikov, V.A.; Skupov, V.D. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/dislocations; SILICON/ion implantation; ARGON IONS; KEV RANGE 10-100; LATTICE PARAMETERS; MICROHARDNESS; ORIENTATION; PHYSICAL RADIATION EFFECTS; SILICON; DISLOCATIONS

40471 (INIS-SU–98, pp. 148) **Proton irradiation effect on properties of surface layer of iron-nickel alloy.** Tsurin, V.A.; Sorokin, A.M.; Pavlov, V.A.; Stepanov, A.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged*

particle interaction with crystals. Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

IRON BASE ALLOYS/crystal-phase transformations; IRON BASE ALLOYS/physical radiation effects; KEV RANGE 10-100; LAYERS; MANGANESE ADDITIONS; NICKEL ALLOYS; PROTONS; SURFACES

40472 (INIS-SU–98, pp. 149) **Anomalous effects in metallic alloys under electron beam irradiation.** Vereshkov, G.M.; Grazhdankin, V.N.; Dubovtsev, I.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

IRON BASE ALLOYS/diffusion; IRON BASE ALLOYS/physical radiation effects; BINARY ALLOY SYSTEMS; CHROMIUM ALLOYS; ELECTRON BEAMS; DIFFUSION; KEV RANGE 01-10; KEV RANGE 10-100; NICKEL ALLOYS; PHASE TRANSFORMATIONS; SILICON ALLOYS

40473 (INIS-SU–98, pp. 152) **Field-ion microscopy of Cu_3Au alloy after implantation.** Syutkin, N.N.; Ivchenko, V.A.; Bunkin, A.Yu. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

COPPER ALLOYS/ion implantation; COPPER ALLOYS/order-disorder transformations; ARGON IONS; GOLD ALLOYS; ION MICROSCOPY; KEV RANGE 10-100; NITROGEN IONS; RADIATION DOSES; SURFACES

40474 (INIS-SU–98, pp. 113) **Behaviour of implanted hydrogen and helium in stainless steel.** Belyanin, O.P.; Guseva, M.I.; Sulema, V.N.; Stolyarova, V.G.; Cherdantsev, Yu.P.; Chernov, I.P.; Shadrin, V.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

STEEL-CR18NI10TI/chemical composition; STEEL-CR18NI10TI/ion implantation; BLISTERS; DOSE-RESPONSE RELATIONSHIPS; HELIUM IONS; HIGH TEMPERATURE; HYDROGEN IONS; KEV RANGE 10-100; MEDIUM TEMPERATURE; SPATIAL DISTRIBUTION; STEEL-CR18NI10TI

40475 (ISN–89-11) **Development of a new process for deposition of metallic vapours and ions.** Gabrielli, O. de. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1989. 79p. (In French). Order Number DE89903296/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Surface treatment processes by deposition, enabling surface properties to be altered without altering the volume, are making rapid progress in industry. The description of these processes has led us to consider the role and the importance of methods using plasmas. The new plasma source we have developed is the subject of this experimental research: it is the basis of the deposition process (metallic ion and vapour deposition). The specifications and preliminary results enable us to compare this process with others in use. Fast deposition rates and excellent adhesion are the two main characteristics of this process.

40476 (KFK–4552) **Corrosion studies on the material combination used for the POLLUX cask for direct disposal of spent fuel elements in rock salt formations.** Smailos, E.; Fiehn, B. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik. Mar 1989. 27p. (In German). Order Number DE89794943/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A high rank is attributed to the packaging under the concept of direct disposal of spent fuel elements in a rock salt formation. The packaging has to ensure over a period of 500 years (working hypothesis) the safe containment of the wastes against the mechanical load of the rock pressure and the attack of corrosive salt brines in hypothetical accident scenarios in a repository. The POLLUX container system developed by DWK under these aspects provides a mechanically stable disposal container (steel 15 MnNi 6.3) with a corrosion protection layer of Hastelloy C4 applied by surface welding onto the body of the disposal container. Shielding against the gamma and neutron radiation is ensured by a surrounding nodular cast iron container and a polyethylene filler on a AlMgSi 0,5 carrier material. In the framework of activities reported here it was examined whether the corrosion behavior of Hastelloy C4 is influenced by surface welding and the simultaneous corrosion of the different POLLUX materials. For this purpose, specimens from two typical surface welds were examined in long-term immersion tests (18 months at the maximum) in three disposal relevant salt brines (two $MgCl_2$-rich brines and one NaCl-rich brine) at 150^0C. Besides Hastelloy C4, also the corrosion behavior of nodular cast iron in salt brines was studied. (orig./MM).

40477 (LA–11540) **Microstructural study of mandrel-bent 1/16-inch stainless steel tubing.** Stevens, M.F.; Archuleta, J.I.; Schonfeld, F.W.; Cramer, E.C. Los Alamos National Lab., NM (USA). Jul 1989. 55p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-26. Order Number DE89014362/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The results of a study to determine the quality of 1/16-in.-o.d. type 316 stainless steel tubing following mandrel bending are presented. Characterization included measurement of nominal bend radii, microphotographic documentation of internal microstructural features, microhardness measurements, and magnetic susceptibility determination. Tube wall thickness measurements indicated no unusual thinning. Examination of longitudinal sections revealed no tendency for cracking, and only mild work-hardening was detected. Magnetic susceptibility determinations revealed little if any tendency for mechanically induced martensite formation. 2 figs., 4 tabs.

40478 (LA-UR–89-2486) **The s-d transition and high-pressure phase stability of transition metals.** Shaner, J.W. Los Alamos National Lab., NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890798–5: AIRAPT and EHPRG international high pressure science and technology conference, Paderborn (Germany, F.R.), 17-21 Jul 1989). Order Number DE89015345/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The recent discovery of a solid-solid phase change in shock-compressed Mo and the theoretical interpretation suggest valence d-electron density as a major influence on structural stability. The relationship of this experimental result to the transition metal structures and alloy phase diagrams will be discussed. Specific predictions will be presented for the locations and slopes of transition metal and transition metal alloy phase boundaries. 9 refs., 1 fig., 1 tab.

40479 (LYCEN–8830) **Titanium implantation into a high speed steel. Distribution parameters and CEMS characterization.** El Khakani, M.A.; Jaffrezic, H.; Marest, G.; Moncoffre, N.; Tousset, J. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. Jul 1988. 12p. Order Number DE89903224/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The AISI M2 high speed steel was implanted with 110 keV titanium ions at 20^0C and with fluences varying between 5×10^{16} and 4×10^{17} Ti.cm^{-2}. For each fluence, theoretical distributions were calculated taking into account the variation of both the titanium concentration as a function of depth and the distribution parameters (Rp, ΔRp, skewness, kurtosis, sputtering yield). A comparison was made beteen these results and experimental ones. It concerns more precisely the titanium profiling using the ^{48}Ti (p, γ)^{49}V resonant nuclear reaction at 1362 keV and the sputtering yield measurements of iron. Moreover carbon and oxygen contaminations were followed at

room temperature and 180°C as a function of fluence thanks to the backscattering spectroscopy at high energy. A characterization of the created phases was performed with conversion electron Moessbauer spectroscopy. The results were correlated in order to propose a general arrangement of the phases inside the implanted layer.

40480 (PtUB–21, pp. 9-22) **Release of radionuclides from Zircaloy or boron carbide.** Kopp, D. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernchemie); Schnarr, K.; Praetorius, R.; Muenzel, H.; Braun, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5564. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

A report is presented on the distribution of ^{14}C and ^{135}Xe in Zircaloy after reactor irradiation and on temperature-dependent emission into the environment, as well as on the release of tritium from the control rod materials B_4C and EuB_6. (RB).

40481 (PtUB–21, pp. 205-224) **Study of corrosive behaviour of container or electrode metals in the presence of plutonium by means of specific electrochemical, radiochemical, and photochemical methods.** Marx, G. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Anorganische und Analytische Chemie); Wegen, D.; Schoenemann, W.; Helmke, L.; Schuler, M.; Grewe, J.; Wille, D. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5857. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The corrosion of high-alloy steels, niobium, vent and electrode metals as materials used in the Purex process is investigated by means of a combination of electrochemical and radioisotope methods in the presence of plutonium. Thus, the growth of oxide layers and small corrosion rates can be determined. Two models are discussed for the structure of the passive layer. From the ratio of the alloy constituents determined in the solution, conclusions can be drawn as regards the thickness or the composition of the passive layer. For a further characterization of oxide layers of Ti, Zr, Hf, Nb and Ta, a photoelectrochemical measuring station was set up and tested. (RB).

40482 (PtUB–21, pp. 225-238) **Effects of β^-radiation and gamma radiation on the corrosion of stainless steel in nitric acid.** Schnarr, K. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernchemie); Muenzel, H.; Braun, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5675. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

For the quantitative description of the radiation influence, the complex reaction of the highgrade steel/HNO_3/Cr^{6+} system was first investigated in detail without the effect of radiation. For this purpose the individual influence of the following parameters on the corrosion rate was investigated and the results were summed up in a model: mass removal, chromate concentration, nitric acid concentration in the presence of Cr^{6+}, temperature. Under the influence of the gamma radiation of an external Co-60 source, the mass removal curve to be calculated by the model is indirectly changed by the radiation-chemical reduction of the chromate. The influence of the beta radiation field can be ignored. (orig./RB).

40483 (PtUB–21, pp. 239-249) **Corrosion of steel in hot brine.** Heusler, K.E. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Abt. Korrosion und Korrosionsschutz); Huemer, R.; Kusian, B. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5655. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

On an unalloyed steel, an oxide layer grows in aqueous solutions according to the parabolic time law. The corresponding velocity constant is independent of the chloride content of the solution. The velocity constant does not follow an Arrhenius line, but reaches a peak at a temperature of about 250°C. In the absence of chloride, the stationary corrosion rate in a neutral aqueous solution is always very low. An addition of a small quantity of chloride causes strong variations of the corrosion rate. This is to be explained by local corrosion. Holes covered by an oxide layer, however, grow towards depth only during a limited time. This effect leads to an increase in the average stationary corrosion rate particularly in concentrated chloride leaches. The design of a high-temperature apparatus for thermodynamic measurements on iron at temperatures of up to 250°C and pressures of up to 4 kbar is described. (orig./RB).

40484 An assessment of a-SiGe:H alloys with a band gap of 1.5eV as to their suitability for solar cell applications. VonRoedern, B. (Glasstech Solar, Inc., Wheatridge, CO (US)); Madan, A.; Mahan, A.H.; McMahon, T.J. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

Hydrogenated amorphous silicon germanium alloys a-$Si_{1-x}Ge_x$:H are being actively investigated for their application as a low band gap material in cascade solar cells. To date, such alloys produce material of a reasonable electronic quality only if the Ge-content is kept low (<40 at.%) such that the band gap is not decreased much below 1.5 eV. Conversion efficiencies of ~5% have been obtained with alloys having such a band gap, and tandem cells have shown conversion efficiencies which are lower than those of good quality single layer a-Si:H devices. Thus, the performance of alloys is well below that necessary to achieve conversion efficiencies of >16%, which are ultimately hoped to be obtained using the cascade approach. Other low band gap alloys such as a-$Si_{1-x}Sn_x$:H have been shown to be even less suitable with regard to their electronic properties. The cause of the degradation in electronic properties with increased alloying is not yet understood. Factors such as preferential attachment of H to Si rather than Ge or microstructure observed in alloys have been suggested as a cause for the electronic degradation, but no unique correlations have been established between such findings and the electronic properties.

3602 Ceramics, Cermets, and Refractories

Refer also to citation(s) 40415, 40444, 40445, 40546, 40621, 40725

40485 (ANL–89/3, pp. 52-63) **Materials effect in the manufacturing revolution: emphasis on advanced ceramics.** Wachtman, J.B. Jr. (Rutgers Univ., Piscataway, NJ (USA)). Argonne National Lab., IL (USA). Feb 1989. (CONF-8806303–: Conference on advanced materials in the manufacturing revolution, Argonne, IL (USA), 14 Jun 1988). In *Advanced materials in the manufacturing revolution. Proceedings.* Order Number DE89008190/JAW. Available from NTIS, PC A05/MF A01.

The field of advanced ceramics includes a wide diversity of materials. Such ceramics can be organized into categories by the functions which they perform. These functions, given with examples a table, depend upon the special properties that can be designed into ceramics, properties that in turn depend ultimately on the fundamental characteristics of the chemical bonding. A central theme of this paper is that properties achievable in ceramics often make them the material of choice despite the fact that they have some limitations as well as desirable features. The author first discusses functions ceramics can perform in a unique way and then treats specific ceramic materials that provide these functional requirements. He also devotes brief sections to processing and design considerations and market factors. 5 figures, 3 tables.

40486 (CEA-R-5480) **Irradiation damage in gamma lithium aluminate.** Auvray-Gely, M.H. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires; Paris-11 Univ., 91 - Orsay (France). 1989. 173p. (In French). Order Number DE89903268/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Single crystals of gamma lithium aluminate (of tetragonal structure) are irradiated with various projectiles (electrons, He ions, protons, X and gamma photons) and we used (i) electronic paramagnetic resonance (EPR) and optical absorption to detect the defects produced, and (ii) transmission electron microscopy (TEM). The lithium aluminate single crystals irradiated with electrons or ions contain five different paramagnetic defects. Each of them has several anisotropic configurations whose EPR signals (i) have a Lande factor close to 2, (ii) exhibit a resolved hyperfine structure and (iii) are identical only when the static magnetic field is along / 001/. In addition, four optical absorption bands appear in the range 1-6 eV in the same irradiation conditions. But only three among the five paramagnetic defects and one of the optical bands appear in X- and gamma-ray irradiated samples. Using these observations, we discuss the nature of the detected defects and we conclude about the type of their production mechanism. Particularly, we assign a six-line EPR signal and an optical band in the ultraviolet range to the F^+-centre. We compare this hypothesis to a defect model based on the computation of approximate electronic wave functions using the variational method. Our TEM study shows that when gamma-$LiAlO_2$ single crystals are irradiated with 1 MeV electrons (fluence: 10^{20} electrons/sqcm), tridimensional defects (of mean dimension 100 nm) appear. At lower energies, the defect production is hidden by a thermal effect that is sufficient to induce the evaporation of lithium oxyde and the formation of $LiAl_5O_8$.

40487 (CONF-890508-1) **Measuring the shielding effectiveness of superconductive composites.** Pienkowski, T.; Johnson, D.; Lanagan, M.T.; Poeppel, R.B.; Danyluk, S.; McGuire, M. Argonne National Lab., IL (USA). 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From IEEE international symposium on electromagnetic compatibility; Denver, CO (USA); 23-25 May 1989. Order Number DE89015164/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The ability to cool superconductors with liquid nitrogen instead of liquid helium has opened the door to a wide range of research. The well known Meissner effect, which states superconductors are perfectly diamagnetic, suggests shielding applications. One of the drawbacks to the new ceramic superconductors is the brittleness of the finished material. Because of this drawback any application which required any flexibility would be impractical. Therefore, this paper presents the results of a preliminary investigation into the measuring of shielding effectiveness of $YBa_2Cu_3A_{7-x}$ both as a composite and as a monolithic material. A flanged coaxial test fixture was selected to measure the shielding. The composite samples showed little or no shielding. The monolithic sample showed substantially less shielding than predicted. Possible explanations for this lack of shielding are discussed. 6 refs., 3 figs.

40488 (CONF-8906179-1) **Ceramic processing of bulk high-T_c superconductors.** Leu, Hongi J. Argonne National Lab., IL (USA). Apr 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From Mid-America Chinese Professional annual convention; Chicago, IL (USA); 2-4 Jun 1989. Order Number DE89015703/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Processes are presented for the fabrication of high-T_c $YBa_2Cu_3O_{7-\delta}$ bulk oxide superconductors. The electrical and mechanical properties of the tapes cast by the doctor blade technique and wires prepared by extrusion have been characterized. Microstructural effects on these properties are discussed. Characteristics of new Bi- and Tl-based oxide superconductors are briefly reviewed. 7 refs.

40489 (CRIE-W-87042) **Thermophysical properties of ceramics (2). Development of specific-heat-measurement apparatus at high temperature.** Takahashi, Takeshi; Hamamatsu, Teruhide; Ishikawa, Hiroshi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jun 1988. 22p. (In Japanese). Order Number DE89760382/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

It is necessary to study the thermal properties of ceramics in order to apply to high temperature field or high heat flux such as high temperature service in a gas turbine or abrasion portions, burners of a boiler. A specific heat measurement apparatus with measure temperature range of 500^0K to 2300^0K was developed. A drop calorimeter method was adopted for the measurement, and a graphite furnace was used for the temperature increase, which is possible to increase up to 2600^0K. A sample with M (g) weight and temperature of $T_m(^0C)$ is dropped into the calorimeter with water temperature of $T_r(^0C)$. A specific heat (C_p) of sample is represented by a following formula; $C_p = W^*D_t/M^*(T_m-T_r-D_t)$ where $D_t(^0C)$ is water temperature increasing, W (g) the sum of the water quantity and a water equivalent of the calorimeter. Double insulating structure of the calorimeter showed superior performance. The specific heats of SiC were measured at the range of 800-2200^0K with satisfactory results, and the measurement error is less than -3.0% at 1800^0K. 20 figures, 2 tables.

40490 (DOE/ER/45258-T3) **The effects of point defects and stoichiometry on structural phase transitions: Progress report, June 15, 1988-June 14, 1989.** Toulouse, J. Lehigh Univ., Bethlehem, PA (USA). Dept. of Metallurgy and Materials Engineering. 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER45258. Order Number DE89015758/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this report, we have discussed the effects of point defects on structural phase transitions in $KMnF_3$ and $KTaO_3$. $KMnF_3$ is a fluoperovskite that undergoes a cubic-to-tetragonal transition at 186.6°K. Here, this transition has been studied in Li-doped crystals. $KTaO_3$ is an oxyperovskite that does not undergo a phase transition until it is doped with Nb or Li. The transition temperature T_c is then directly related to the defect or impurity concentration. These two systems are also representative of two separate types of phase transitions. This particular choice was made so as to be able to contrast the respective results obtained on the two systems and thus establish a general framework of reference.

40491 (INIS-SU-89, pp. 163-164) **Thermal stability of electrical properties of $LiNbO_3$ crystals.** Zakharov, N.A. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Egorov, A.V.; Orlovskij, V.P.; Murav'ev, Eh.N.; Zakharova, T.V.; Mergelyan, O.S. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

LITHIUM COMPOUNDS/piezoelectricity; NIOBATES/piezoelectricity; PIEZOELECTRICITY; LOW TEMPERATURE; MONOCRYSTALS; NIOBATES; PERMITTIVITY; TEMPERATURE DEPENDENCE

40492 (KEK-88-7, pp. 137-146) **Thermionic cathode materials for ion sources.** Hagiwara, H. (Denki Kagaku Kogyo K.K., Tokyo (Japan)); Yamada, S.; Rokugawa, A.; Ehara, K. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288-: Symposium on negative ion sources and their applications, Tsukuba (Japan), 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Borides, carbides and nitrides which are promising thermionic cathode materials have been evaluated by discharging in not only Ar but also reactive gases with a Freeman type ion source in point of life time. Although the difference of material loss rate between LaB_6 and W in test of Ar discharge is very little, life time of LaB_6 is expected to be much longer than that of W under the same heating power. LaB_6 reacts severely with reactive gases such as BF_3 and Ar-10% O_2. In the other way, LaB_6 and ZrN perform better than W in discharge of N_2.

40493 (LBL–27218) **Incommensurable surface spin structures in MnO-type antiferromagnets.** Falicov, L.M.; Chrzan, D.C. Lawrence Berkeley Lab., CA (USA). May 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8905188–1: Conference on magnetic properties of low-dimensional systems II, San Luis Potosi (Mexico), 22-26 May 1989). Order Number DE89015314/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A theory for the phase stability of incommensurable spin structures on the {001} surfaces of the rock-salt antiferromagnets is presented. It consists of classical spins and a simple Heisenberg Hamiltonian dependent on three exchange interactions: (a) a surface-only nearest-neighbor exchange; (b) a surface-second-layer nearest-neighbor exchange; and (c) an antiferromagnetic second-nearest-neighbor superexchange throughout the crystal. Incommensurable magnetic surface structures are proven to be the ground state for a wide range of the surface exchange parameters. 21 refs., 6 figs.

40494 (ORNL/FTR–3318) **[Seventh European conference on chemical vapor deposition, Perpignan, France, June 19–23, 1989]: Foreign trip report.** Besmann, T.M. Oak Ridge National Lab., TN (USA). 13 Jul 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015732/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler, T.M. Besmann, participated in the Seventh European Conference on Chemical Vapor Deposition held in Perpignan, France. The conference included invited papers reviewing all important areas of chemical vapor deposition as well as recent advances. The conference also included a small industrial exhibition (~12 companies).

40495 (ORNL/FTR–3319) **[Ceramic components in machines], Cologne and Aachen, West Germany, Maastricht, The Netherlands, and Brussels, Belgium, June 14-27, 1989: Foreign trip report.** Tennery, V.J.; Long, E.L. Jr. Oak Ridge National Lab., TN (USA). 18 Jul 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015831/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Structural ceramic research at the DLR is heavily focussed on silicon carbide whisker reinforced silicon nitride matrix composites and upon processing of monolithic silicon nitride compositions. Extensive research is also underway on aircraft alloys, including metal-polymer fiber and carbon-carbon composites. The IKKM, a new German research institute in Aachen, has a growing program focussed on characterizing ceramic components by techniques which can ultimately be used by German industry to produce highly reliable structural ceramic products. Residual stress, ultrasonic, and x-ray tomography techniques are the main thrust of the present program. The travelers attended the first meeting of the European Ceramic Society held at Maastricht, The Netherlands. The IEA Annex II Executive Committee held a meeting and voted approval of two new subtasks, Subtask 5 on mechanical properties and Subtask 6 on ceramic powders. An overview of the newly formed European Community Research and Development Program on Manufacturing Technologies and Advanced Materials for 1989–1992 was gained during a visit to the Commission of the European Communities in Brussels, Belgium.

40496 (PNL-SA–16864) **Alpha irradiation effects in $Ca_2Nd_8(SiO_4)_6O_2$.** Weber, W.J.; Greegor, R.B. Pacific Northwest Lab., Richland, WA (USA). May 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8906155–2: Radiation effects in insulators-5: crystalline oxides and ceramics session, Hamilton (Canada), 19-23 Jun 1989). Order Number DE89015514/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The effects of alpha irradiation in the rare-earth silicate, $Ca_2Nd_8(SiO_4)_6O_2$, was investigated by x-ray diffraction, x-ray absorption near-edge spectroscopy (XANES), and extended x-ray fine structure (EXAFS) techniques. Irradiation with alpha particles emitted isotropically from a $^{238}PuO_2$ source to a cumulative dose of 2.25×10^{21} alphas/m^2 (0.36 dpa) produced measurable anisotropic lattice expansions, with no tendency toward the amorphization that was previously reported due to self-radiation damage in Cm-doped samples at similar displacement-damage (0.25 dpa) levels. The unit-cell volume expanded exponentially with dose to a value corresponding to 2.5% expansion at saturation. The fluorescence XANES data of irradiated surfaces indicate a rearrangement of the near-neighbor ions about Nd. The EXAFS results indicate an irradiation-induced increase in structural disorder that becomes readily apparent at distances of several coordination spheres away from Nd. 14 refs., 5 figs.

40497 (PtUB–21, pp. 309-321) **Study into the preparation and characterization of neptunium target materials.** Clement, S. (Muenchen Univ. (Germany, F.R.). Radiochemische Abt.); Hellmann, H.; Hoffmann, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5574. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

A homogeneous mixed oxide of the Np/ZrO_2 system is aimed at as a target material for the conversion of neptunium-237 into plutonium-238 by means of reactor irradiation (suitable for pacemakers and heat sources). A series of homogeneous mixed crystals of 1-100 mol% neptunium was presented and studied in the form of Np/Zr diarsenates as a preliminary stage to the oxide system. After fully annealing these mixed crystals, a two-phase mixture is determined from 20 mol% NpO_2 onwards: a stabilized mixed-oxide phase in addition to that of the unaffected cubic neptunium oxide lattice. During sintering tests, a mixed oxide is present up to a ratio of about 45 mol% NpO_2, a mixed oxide to be indexed monoclinically in a ratio of up to 25 mol% NpO_2, and cubically in a ratio of up to 45 mol%. If NpO_2 is present in larger quantities - as is the case with the burnt diarsenates -, only the two-phase mixture (the cubic mixed oxide beside the unaffected NpO_2) can be perceived. (orig./RB).

40498 (PtUB–21, pp. 331-341) **Doping of boron carbide with metals.** Lehnert, T. (Muenchen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie); Amberger, E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5625. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The attempt is made to prepare inactive boron carbide samples doped with metal atoms. This is done by sintering boron carbide with the metals Li, Cr, Fe, Co, Ni and Cu in the temperature range of 873 K to 1573 K and by chemical gas-phase separation in the presence of $FeCl_3$. When Li is used as doping metal, an expansion of the boron carbide lattice and atom emission spectrometric investigations indicate an insertion. For the other metals, only a boride formation can be detected for the time being. (orig.).

40499 (PtUB–21, pp. 343-362) **Applicability of a high-temperature diffractometer for the investigation of U-Pu-O systems at temperatures up to 2000°C.** Hellmann, H. (Muenchen

Univ. (Germany, F.R.). Radiochemische Abt.); Theissig, W.; Hoffmann, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5454. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The gaps in the knowledge about the mixed phase behaviour in the U-Pu-O system in the temperature range between 1000 and 2000^{0}C were to be filled in by the project. The complementing data from X-ray structure analysis, thermogravimetry and differential thermal analysis are important for the investigation of such systems. The investigations first dealt with the presentation of stoichiometrical $UO_{2.00}$ and its sintering behaviour at temperatures of up to 1600^{0}C. For the investigation of the high-temperature behaviour of stoichiometrical and non-stoichiometrical mixed U-Pu oxides, a Mendenhall furnace was built and tested and finally, a high-temperature diffractometer chamber for measurements at small radioactive substance quantities (glovebox) was put into operation. The report discusses the difficulties in obtaining reproducible results (O/M ratios, lattice constants) with these devices. (orig./RB).

40500 (SAND–89-0525C) **Pressure dependence of T_c in $Nd_{1.85}Ce_{0.15}CuO_4$.** Schirber, J.E.; Ventturini, E.L.; Morosin, B.; Ginley, D.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 2p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890718–10: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89014548/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

There is considerable interest in the NdCeCuO system because of the reported n-type carrier behavior of the $Nd_{1.85}Ce_{0.15}CuO_4$ superconductor. Further interest stems from the fact that the Cu in the parent compound Nd_2CuO_4 is four-fold coordinated in the so-called T′ phase rather than the six-fold coordination found in La_2CuO_4 or the five-fold coordination in YBaCuO. It is of interest to compare the pressure dependence of this new system with the by now well documented behavior of the other CuO_2 based superconductors. In view of this we present preliminary measurements of the hydrostatic pressure dependence of $Nd_{1.85}Ce_{0.15}CuO_4$.

40501 (UCRL–101082) **Oxygen vacancy ordering in $YBa_2Cu_3O_{7-y}$.** Sterne, P.A.; Wille, L.T. Lawrence Livermore National Lab., CA (USA). Jun 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890718–11: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89015722/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

First principles total energy calculations have been performed for $YBa_2Cu_3O_x$ with x varying from 6.0 to 7.5. The results of these calculations have been used to determine the effective pair interactions for the oxygen ordering in the basal plane. The phase diagram calculated with these "first principles" pair interactions is in very good agreement with experiment. Comparison of the total energies for the O_8, $O_{8.5}$ and O_7 structures shows that the double-cell phase is thermodynamically stable. 9 refs., 1 fig.

40502 Adhesion in solids; Proceedings of the Symposium, Reno, NV, Apr. 5-7, 1988. MRS Symposium Proceedings. Volume 119. Mattox, D.M.; Baglin, J.E.E.; Gottschall, R.J.; Batich, C.D. 325p. Materials Research Society, Pittsburgh, PA (1988). (CONF-8804117–: Adhesion in solids, Reno, NV (USA), 5-7 Apr 1988).

The present conference on adhesion phenomena in solids discusses topics in fracture mechanics, tribology, postdeposition treatments, deposited inorganic films, the adherence of natural layers and surface treatment of polymers, and analytical techniques. Attention is given to the mechanics of the peel test for thin-film adhesion, the direct observation of friction at the atomic scale, the enhancement of thin-film adhesion by MeV-ion and keV electron bombardment, metal-ceramic interfacial reactions, the adhesion of growing oxides to metallic substrates, polyimide adhesion as a function of substrate structure, the surface characterization of sputter-etched polymer films, photochemical changes of Al films on Si, and thin-film adhesion to ion-bombarded surfaces.

40503 Transient photoconductivity studies of a-Si:H interfaces. Street, R.A. (Xerox Palo Alto Research Center, Palo Alto, CA (US)). vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

The application of transient photoconductivity to the study of contacts and interfaces with a-Si:H is reviewed. The photocurrent is shown to contain three terms - one from the drift of photogenerated carriers, and two from contact and bulk effects due to the electric field induced by the drifting carriers. For different sample configurations, each of these terms can dominate, and each gives different information about a-Si:H bulk or surface electronic properties. The effects are illustrated with data from metal contacts, dielectric interfaces, doped layers and gap cell measurements.

40504 Recombination under double injection conditions in a-Si:H based diodes. Madan, A. (Solar Energy Research Institute, Golden, CO (US)); Konenkamp, R. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

The junction recovery technique is used to investigate recombination parameters and kinetics in thin film a-Si:H diodes. It is found that double injection occurs in most of the p-i-n type samples at sufficient forward bias and that the recovery currents are dominated by the extraction of trapped holes from the valence bandtail. The mobility-lifetime product of the recovered carriers is seen to be strongly dependent on the dopant concentration in the active layers of the devices.

40505 Nonlinear absorption in ultraviolet window materials. Taylor, A.J. (Los Alamos National Lab., Los Alamos, NM (US)); Gibson, R.B.; Roberts, J.P.; Tallman, C.R. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

Recent advances in high-brightness UV lasers have generated interest in the nonlinear optical properties of UV window materials. Such high-brightness laser systems, based on the amplification of picosecond or subpicosecond pulses in excimer laser media, are routinely delivering peak optical powers of 10-50 GW to a 1-2-cm^2 output window with as much as 100 GW/cm^2 expected in future systems. For further significant increases in output peak power, wider-aperture (50-100-cm^2) amplifiers are essential. Such large apertures require relatively thick output windows. Therefore, understanding nonlinear optical phenomena at intensities of 10^{10}-10^{11} W/cm^2 in UV window materials is essential for the design of such amplifiers. Such nonlinear effects may ultimately limit the achievable peak power from high-brightness systems in the UV.

40506 The effect of $Ca(OH)_2$-treated ceramic microspheres on the mechanical properties of high-temperature lightweight cement composites. Sugama, T. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY (US)). vp. of Bonding in cementitious composites. Mindess, S.; Shah, S.P. Materials Research Society, Pittsburgh, PA (1988). (CONF-871250–: Symposium on bonding in cementitious composites, Boston, MA (USA), 2-4 Dec 1987).

The compressive strength and water permeability of high-temperature lightweight cementing materials containing sillimanite-based hollow microspheres as a filler can be improved by treating the surfaces of the microspheres with a $Ca(OH)_2$-saturated solution at temperatures up to 200^{0}C. The precipitation of an epitaxial layer formed by an interaction between a hot calcium hydroxide solution and the surface of the sphere plays an essential role in developing favorable bonding characteristics at the interfaces

and in promoting the hydration of the cement matrix. The properties of the composites include a slurry density of <1.2 g/cc at 25°C, a 300°C-24 hour compressive strength of >1015 psi (7.0 MPa), a water permeability of $<10^{-4}$ Darcy, and a bulk density of <1.0 g/cc. It was observed that tobermorite-truscottite transformation and anorthite formation during autoclave exposure for 180 days in brine at 300°C results in slight strength reductions and increased water permeability.

40507 **Mechanical properties and microstructure of short alumina fiber reinforced magnesium alloy.** Sayashi, M.; Hino, H.; Komatsu, M.; Sasaki, M. vp. of How to apply advanced composites technology. ASM International, Metals Park, OH (1988). (CONF-8809370–: 4. annual conference on advanced composites, Dearborn, MI (USA), 13-15 Sep 1988).

The possibilities of using squeeze-cast short alumina fiber-reinforced AZ91 as a lightweight material to reduce the weight of automotive parts were investigated. Problems related to material fabrication were resolved, fiber preforms were improved, and the properties of the material were clarified. The Young's modulus of the material, containing 9.5 percent fiber by volume and without heat treatment, was smaller than that of a T6 heat-treated 336 aluminum alloy. Although the tensile strength and fatigue strength wre inferior at room temperature, they were superior at 573 K to those of the 336 alloy. The material showed excellent specific strength at the higher temperature, but the creep strength was inferior to that of the 336 alloy. 5 references.

3606 Other Materials

Refer also to citation(s) 39864, 39867, 39984, 40011, 40030, 40031, 40048, 40116, 40140, 40141, 40190, 40191, 40414, 40439, 40484, 40494, 40502, 40505, 40836, 40850, 40851, 41055, 41316, 41319

40508 (ANL–89/3, pp. 9-16) **Developing a new product: disconnects that exist between design, materials selection, materials performance, and manufacturing.** Clagett, R.P. (Univ. of Rhode Island, Kingston (USA)). Argonne National Lab., IL (USA). Feb 1989. (CONF-8806303–: Conference on advanced materials in the manufacturing revolution, Argonne, IL (USA), 14 Jun 1988). In *Advanced materials in the manufacturing revolution. Proceedings.* Order Number DE89008190/JAW. Available from NTIS, PC A05/MF A01.

The author first characterizes the differences in the American and Japanese managerial approaches. Then, having cited these differences and compared the two approaches, he suggests some adaptive changes in the American approach, namely: (1) to make the innovation-to-product process work, all groups of the corporate team must pull together and work in parallel; (2) customer needs must be thoroughly examined before the design is started; (3) all the relevant technologies must have an input, especially materials technology; (4) iterative critiquing and discussing by all participating groups in the organization should occur throughout creation and initial production; and (5) organizational walls and barriers should be broken down by whatever means are appropriate to the particular company. 3 figures.

40509 (ANL–89/3, pp. 37-51) **Developing trends and characteristics of high-performance polymers and composites: manufacture, supply, and use.** Riggs, J.P. (Hoechst Celanese Corporation, Summit, NJ (USA)). Argonne National Lab., IL (USA). Feb 1989. (CONF-8806303–: Conference on advanced materials in the manufacturing revolution, Argonne, IL (USA), 14 Jun 1988). In *Advanced materials in the manufacturing revolution. Proceedings.* Order Number DE89008190/JAW. Available from NTIS, PC A05/MF A01.

General conclusions regarding developments in high-performance polymers and composites can be summarized as follows: (1) metal replacement is the main determinant for growth and, although penetration is small, a rapid growth phase is developing; (2) there is a somewhat confusing array of materials options available and, in many respects, materials development has greatly out-paced the ability of many manufacturers to incorporate new materials; (3) there is likely to be a growing overlap in performance and use among a variety of materials; (4) the major shortcomings of advanced polymeric based materials are in the areas of elevated-temperature performance, relatively high materials cost, and processability; (5) the engineering plastics business will continue rapid development; (6) modification of existing materials through filling/blending/reinforcing/alloying will continue to be a key direction for development; (7) fabrication and processing are critical issues and this has a number of implications; (8) the role of the materials supplier is changing and broadening. 2 references, 6 figures, 6 tables.

40510 (CRN-CPR–88-06) **Development of a new technique of localised analysis of electrically active defects in semiconductors.** Heiser, T. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Jul 1988. 79p. (In French). Order Number DE89903287/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

An analysis technique derived from minority carrier transient spectroscopy (MCTS) was developed. By giving this technique spatial resolution via a focused optical beam, it is possible to exploit the high sensitivity and the spectroscopic nature of the technique to develop a method called scanning MCTS (SMCTS) which can be used to acquire information on lateral distribution of electrically active flaws in semiconductors or associated chemical impurities. The optimum conditions, corresponding to the maximum signal for the highest resolution, can be expressed by the value of a signal parameter. The transients system was digitized, considerably reducing background noise. In order to link the SMCTS to a given flaw, two methods for exploiting the transients are used. The method was verified in tests with artificial defects created by laser and on real cases, arising in industrial processes.

40511 (CRN-CPR–88-07) **Contribution to the study of photophysical reactions implying intramolecular conformational changes.** Rachidi, A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 127p. (In French). Order Number DE89903288/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The stochastic theoretical models which best describe the different conceptual problems encountered in photophysics are discussed. The behavior of the potential barrier in liquids in the framework of single-molecule reactions is stressed. The behavior of the DMABN molecule, where an electron transfer with a change of conformation seems to occur, is described. The photo-isomerization observed in the binaphthyl molecule and the de-excitation of the pinacyanol model are also described.

40512 (CRN-CPR–88-09) **Contribution to the study of the purification of telluride in view of its application in composite semiconductors used in energy and nuclear detectors.** Zaiour, A.H. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 94p. (In French). Order Number DE89903290/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Different ways to obtain a cadmium telluride with a purity better than 6N were studied in order to improve its physical qualities, as well as the resulting improvements of CdTe. The operating parameters of an economical purification process, which is, however, thorough, with no prior doping, are presented. A sequence of values for the coefficients of segregation, evaporation, and diffusion as a function of melting zone rate and temperature are presented, as well as parameters concerning a final purification: rate, temperature, number of passes, etc. The consequences of the purity of the manufactured CdTe are indicated.

40513 (DOE/ER/45271–T3) **[Molecular ferromagnetism]: Progress report.** Ohio State Univ. Research Foundation, Columbus, OH (USA). [1989]. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER45271. Order Number DE89015022/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The past period has been one of rapid progress in the development of an understanding of the generation and control of ferromagnetism in molecular and polymeric materials. Our accomplishments during this past grant period span all three areas of our research. We have extensively characterized the ferromagnetic transition in the first molecular ferromagnetic system known, (decamethylferrocenium) (tetracyanoethanide). We have synthesized

numerous new materials to test the generality of magnetism in systems and explore the possibility of magnetism in polymeric systems. We have developed a model for the ferromagnetic exchange between local sites as well as an understanding of the approach to three-dimensional ordering in these one-dimensional magnetic materials. We briefly summarize in this paper the major breakthroughs, accomplishments, and discoveries that have occurred during this period.

40514 (EUR–12022) **Influence of bicarbonate ions and redox conditions on the surface composition of a leached borosilicate glass.** Manara, A.; Lanza, F.; Visani, T. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 21p. Available from NTIS (US Sales Only), PC A03/MF A01.

A serie of short leaching tests have been performed on a borosilicate glass (I117) up to a maximum of 40 days. The tests were performed in a closed system in oxic and anoxic conditions and in presence of bicarbonate ions. The bicarbonate ions do not influence the mass losses while the oxic condition gives rise to an higher mass losses. Surface analysis was performed on the surface layer for the elements uranium and iron. Uranium is always depleted at the surface of the samples. It appears that adsorption and diffusion in the layer play an important part in the uranium released. Iron on the contrary is enriched so that solubility of the formed species are responsible of its concentration.

40515 (INIS-mf–11495, pp. 53-54) **Use of external MeV beams to produce implanted layers several microns thick.** Clissold, R.A. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Materials Science and Technology); Kenny, M.J.; Rose, A. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

An external beam technique has been developed to allow hydrogen implants at a range of energies. The beam is brought into a helium atmosphere and the energy of the ions penetrating the sample is varied by moving the sample back and forth. This enables an implant region of several microns to be produced and this is of considerable advantage for improved wear resistance of materials. In the present work, glassy carbon has been implanted using this technique.

40516 (INIS-mf–11495, pp. 55-57) **Assessment of ion damage level of improvement of glassy carbon wear resistance.** Farrelly, M. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Materials Science and Technology); Pollock, J.T.A.; Wielunski, L.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The wear resistance of 1 MeV N^{15} implanted glassy carbon is measured using optical interferometry and N^{15} nuclear reaction profiling. The wear resistance measurements are compared to atomic displacements caused by ion implantation. We found slightly improved wear resistance occurring at atomic displacement levels of 1% and greater wear resistance at higher levels.

40517 (INIS-mf–11495, pp. 58-60) **Self absorption and secondary fluorescence corrections of PIXE from multilayered targets.** Sousens, D.R. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Ryan, C.G.; Sie, S.H.; Griffin, W.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A computer program is described which calculates ion induced X-ray yields and relative intensities from thick targets comprised of multiple compounds layers. The program incorporates corrections for self absorption of the X-rays and the effects of X-ray fluorescence by the matrix elements. It has been optimized to reduced the calculation time both for the primary yield calculations and the X-ray fluorescence correction.

40518 (INIS-mf–11495, pp. 79-81) **Ion beam induced regrowth in GaAs studied by ion channelling.** Johnson, S.T. (Royal Melbourne Inst. of Tech. (Australia).); Williams, J.S.; Elliman, R.G. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Solid phase epitaxial growth of amorphous layers in GaAs has been stimulated by irradiation with MeV Ne^+ ions. This regrowth has been observed to occur at substrate temperatures as low as 75 deg C: well below the normal thermally activated regrowth processes. By measuring the ion-stimulated regrowth of the amorphous layer as a function of ion-dose and substrate temperature an activation energy of $\sim$ 0.16 eV has been determined for the process. This is in contrast to the activation energy of $\sim$ 1.6 eV which has been measured for thermal regrowth.

40519 (INIS-mf–11495, pp. 82-84) **Light-ion damage in GaAs and Si.** Brown, R.A. (Melbourne Univ., Parkville (Australia). School of Physics); McCallum, J.C.; Williams, J.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Recently, we have been interested in light-ion irradiation of Si and GaAs for two reasons : the recent development of ion-beam induced epitaxy and amorphisation has motivated research to identify the major defects controlling these processes; and the use of a He microbeam for analysis of semiconductors has necessitated characterisation of crystal damage and knock-off effects. In this paper we present some results for microbeam damage in GaAs and Si. In order to understand the damage mechanisms in the (more complex) GaAs, macrobeam damage has been investigated.

40520 (INIS-mf–11495, pp. 88) **Ion beam damaging processes in silicon.** Goldberg, R. (Melbourne Univ., Parkville (Australia). School of Physics); Elliman, R.G.; Williams, J.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Abstract only.

40521 (INIS-mf–11495, pp. 89-91) **Ion beam mixing of GaAs ohmic contacts.** Cozzolino, C. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre); Johnson, S.T.; Williams, J.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Thin Sn layers on GaAs have been mixed using Ar^+, Kr^+ and Xe^+ ions at substrate temperatures from -196 deg C to 225 deg C. Both ballistic mixing and radiation enhanced mixing regimes have been identified. In the former regime, peak Sn concentrations exceeding 20 atomic percent are achievable. Subsequent annealing gives rise to eutectic formation and the possible formation of intermetallic compounds which allow satisfactory non-alloyed ohmic contacts to be fabricated.

40522 (INIS-mf–11495, pp. 92-94) **Isolation of GaAs devices by ion bombardment.** Sengupata, D. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre); Johnson, S.T.; Williams, J.S.; Zemanski, J.M. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Epitaxial (n^+-n) layers on semi-insulating GaAs samples were implanted with He^+ ions at elevated temperatures. Samples were analysed to provide sheet resistivity, Hall mobility and carrier depth profiles using electrical measurement techniques and damage distributions using Rutherford backscattering and channeling. All the data were correlated with the objective of identifying the optimum conditions for achieving electrical isolation. Elevated temperature He^+ implants have been found to accomplish uniform, single step isolation of GaAs layers.

40523 (INIS-mf–11495, pp. 95-97) **Oxidation of Ni and Ni-Si based alloys studied by Rutherford backscattering and channeling.** Short, R. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre); Bond, P.; Nygren, E.; Williams, J.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Rutherford backscattering and channeling techniques have been used to study the high temperature oxidation behaviour of Mg ion implanted Ni and Ni-Si based alloys. Both polycrystalline and single crystal targets were studied. Major conclusions are that Mg initially enhances the oxidation rate for polycrystalline targets, where reductions in grain size are observed following implantation, but Mg retards oxidation quite markedly for single crystal substrates, where, in the absence of grain boundaries, a passivating oxide is thought to inhibit bulk migration of oxygen.

40524 (INIS-mf–11495, pp. 98-100) **Titanium silicide reactions analysed by Rutherford backscattering.** Cao, D.X. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre); Harrison, H.B. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Rapid thermal vacuum processing (RTVP) has been used to form titanium silicide ($TiSi_2$). The time/temperature window offered by this technique enables the various phases (Ti_5Si_4, TiSi and $TiSi_2$) to be observed using Rutherford backscattering techniques. Furthermore the kinetics of formation found using this approach lead to an activation energy of $\sim$ 1.7 eV but with a reaction rate constant almost an order of magnitude larger than previously reported data. We also report on a reaction delay time that is consistent with the predisilicide phase formation.

40525 (INIS-mf–11495, pp. 114-116) **Phase transformations in ion implanted Si studied by Rutherford backscattering and complementary techniques.** Thornton, R. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre); Nygren, E.; Williams, J.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

We have observed an amorphous to polycrystalline Si transformation with concurrent Sn redistribution in Sn-implanted Si at temperatures well below those at which solid phase epitaxial growth, or random crystallization, is observed to take place in undoped Si. The process is extremely rapid and characterised by a strong dependence on Sn concentration and temperature. We propose that this is mediated by molten Sn-rich precipitates in the amorphous Si.

40526 (INIS-mf–11495, pp. 108-110) **Ion implantation in ceramics.** Sood, D.K. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Recent developments in understanding the modification of surface properties of ceramics by ion implantation are reviewed. Surface mechanical properties such as hardness, fracture toughness etc., depend on ion beam parameters and thermal treatment during or after implantation. Ion damage, amorphisation, recrystallisation, phase separation and solute diffusion in amorphous or crystalline substrate are shown to be the relevant physical processes involved.

40527 (INIS-mf–11495, pp. 145-147) **Surface structure analysis with three dimensional angle resolved medium energy ion scattering apparatus.** Xu Chen (Newcastle Univ. (Australia). Dept. of Physics); O'Connor, D.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A compact medium energy electrostatic analyser which allows an additional degree of freedom will be described and its application to surface structure analysis discussed.

40528 (INIS-mf–11495, pp. 148-150) **Role of charge excitation in surface analysis.** Wilson, J.M. (Newcastle Univ. (Australia). Dept. of Physics); O'Connor, D.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Some well established methods of surface analysis (Low Energy Ion Scattering LEIS, Medium Energy Ion Scattering MEIS, Secondary Ion Mass Spectrometry SIMS and Electron Impact Desorption ESD) rely on the detection of ions which have escaped the influence to the surface, being analysed or detected by charge sensitive techniques. However there remains an uncertainty related to measured yields as charge transfer processes between the surface and the escaping particle mask the true yield from surface processes. An understanding of the neutralisation processes is essential to allow more accurate quantitative analysis of surfaces with these techniques.

40529 (INIS-mf–11495, pp. 151-153) **Low energy ion scattering from clean Si(110) surface.** Shen, Y.G. (Newcastle Univ. (Australia). Dept. of Physics); O'Connor, D.J.; MacDonald, R.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Various reconstructions of clean Si surfaces have been extensively investigated in the past. Most of the crystal structures have been on the Si(111) and Si(100) surfaces, while the Si(110) surface has received less attention. We have attempted to fill this gap by applying Low Energy Ion Scattering (LEIS) to the clean Si(110) surface. In the present study, we have applied the ICISS technique to the clean Si(110) surface and measured the intensity of scattered ions as a function of both azimuthal orientation and incidence angle. The observed structure in the angular scattering distributions can be explained with the shadow cone model. From comparisons of computer simulation results with experiment, initial analysis indicates that there are missing <100> rows in the surface, and that the structure is significantly different to the bulk terminated (1x1) structure.

4053^ (INIS-mf–11495, pp. 101-103) **Formation of SiC by implantation of C in silicon.** Trinh, X.V. (Royal Melbourne Inst. of

Tech. (Australia). Microelectronics Technology Centre); Sood, D.K.; Pogany, A.P. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Ion implantation of carbon at high doses ($> 10^{17}$ cm^{-2}) into silicon at room temperature and followed by isothermal annealing at temperatures > 550 deg C leads to the formation of SiC, which has been studied by using Rutherford backscattering and channeling technique.

40531 (INIS-mf–11495, pp. 104-107) **Review of ion beam techniques as applied to solid state materials and thin film analysis.** Williams, J.S. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

This paper provides an overview of applications of ion beam analysis techniques to solid state materials and thin film characterisation.

40532 (INIS-mf–11495, pp. 117-119) **Ion beam induced crystallization and amorphization in silicon.** Elliman, R.G. (Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Materials Science and Technology); Linros, J.; Brown, W.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

This study examines the effect of elevated temperature ion irradiation on the thickness of a thin amorphous silicon layer. A dynamical equilibrium between amorphization and crystallization processes is shown to exist for particular irradiation conditions. Analysis suggests that the equilibrium is determined by the stability of the silicon divacancy.

40533 (INIS-mf–11495, pp. 120-124) **Role of ion microbeams in materials science.** Brown, R.A. (Melbourne Univ., Parkville (Australia). School of Physics); McCallum, J.C.; Williams, J.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The principal analytical techniques available for ion beam analysis are Rutherford Backscattering (RBS), PIXE and Nuclear Reaction Analysis (NRA). The non-destructive and direct nature of RBS has made it one of the most useful and commonly used analytical techniques in materials science. The ability to measure elemental depth profiles with resolution down to 20 Angstrom has been invaluable for determining implant distributions, thin-film compositions and diffusion-mediated reactions. The development of ion channeling has enhanced the position of ion beam analysis by adding the potential to depth profile crystal structure and atom location within crystalline targets. The development of the He microbeam has made three-dimensional composition and microstructural analysis possible with RBS and channeling. In this paper, we first discuss the important parameters for microbeam analysis, followed by two applications to materials science where a He microbeam was uniquely capable of providing important data from microstructures.

40534 (INIS-mf–11495, pp. 125-127) **High dose implantation of Zn in c-axis sapphire (α-Al_2O_3).** Bunn, L.A. (Royal Melbourne Inst. of Tech. (Australia). Dept. of Applied Physics); Sood, D.K. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Changes in the amorphous layer, produced by high dose implantation of Zn ions into sapphire, upon annealing are studied. While for lower doses of implantation the amorphous layer converts to γ-phase at 800 deg C before regrowth of the α-phase occurs, it is seen that there is a critical dose of Zn above which the amorphous layer does not change but instead shows loss of Zn from the surface.

40535 (INIS-mf–11495, pp. 128) **RBS analysis of tin and gold diffusion in GaAs.** Meglicki, G. (Western Australia Univ., Nedlands (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Abstract only.

40536 (INIS-mf–11495, pp. 193-195) **Anomalous diffusion of indium in Al_2O_3 amorphised by ion implantation.** Cao, D.X. (Royal Melbourne Inst. of Tech. (Australia). Microelectronics Technology Centre); Sood, D.K. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The diffusion of indium in α-axis sapphire amorphised with high dose In implantation was studied. During isothermal annealing at 600 deg C, diffusion behaviour was strongly dependent on dose. For dose of $6x10^{16}$In/cm^2, implanted layer still remained amorphous, the indium profile broadened, and there was a long diffusion tail into underlying crystal. For lower dose of $1x10^{16}$ and $3x10^{16}$In/cm^2 no such diffusion was observed.

40537 (INIS-mf–11495, pp. 196) **Depth profiling of implanted N in steel.** Veitch, C.J. (Royal Melbourne Inst. of Tech. (Australia)); Paterson, P.J.K.; Pollock, J.T.A. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Abstract only.

40538 (INIS-mf–11495, pp. 199) **Scattering of low energy molecular ions from solid surfaces.** Snowdon, K. (Osnabrueck Univ. (Germany, F.R.). Fachbereich Physik). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Abstract only.

40539 (INIS-mf–11495, pp. 200-202) **Ion beam induced mixing during ISS depth profiling.** Puranik, S.G. (Newcastle Univ. (Australia). Dept. of Physics); King, B.V.; MacDonald, R.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Study of ion beam induced mixing during depth profiling of thin film structures and ion implanted samples is now a well established area of research. The layer by layer removal of a sample surface by ion beam sputter etching has the ability to give high depth resolution. However, the damage created by ion bombardment deep inside the solid causes mixing at the deeper interfaces. Atomic mixing during depth profiling has been mainly studied by AES and

SIMS techniques. We describe the use of Low Energy Ion Scattering Spectroscopy (LEIS) to study ion beam induced mixing of thin films during depth profiling.

40540 (INIS-mf–11495, pp. 203-205) **Channelling analysis of epitaxially grown thin layers.** Wielunski, L.S. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Materials Science and Technology). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Epitaxy is often used in semiconductor production to form a thin single crystal layer on top of a single crystal substrate. Due to different lattice parameters and thermal expansion coefficients, substantial strain is usually present in epitaxial thin film as well as misfit dislocations on the interface. MeV channelling is used to monitor crystal quality in the CaF_2/Si system as well as interfacial dislocations. The results of the new direct scattering on dislocations theory are used in quantitative dislocation density measurements.

40541 (INIS-mf–11495, pp. 220-223) **Appon of ion beam surface interactions.** Pollock, J.T.A. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Materials Science and Technology). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Ion beams are finding increasing use as research tools and for application. They provide highly versatile methods for modifying the near surface region of solids and in combination with deposition techniques are often able to generate coatings which may be otherwise unobtainable. Aspects of ion beam techniques and the modification or coating of non-semiconductor materials will be briefly reviewed.

40542 (INIS-SU–89, pp. 189) **Structure and mass transfer in alkal-borate glass Me_2O-B_2O_3 (Me=Li, Na, K, Rb).** Khodyakov, A.A. (AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii); Saunin, E.I.; Gromov, V.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/glass; ALKALI METAL COMPOUNDS/mass transfer; BORON COMPOUNDS/glass; BORON COMPOUNDS/mass transfer; GLASS; DIFFUSION; OXIDES

40543 (INIS-SU–89, pp. 189-190) **Role of rare alkali elements in formation of structure and properties of fluorophosphate glass.** Galant, V.E.; Smirnova, E.V.; Urusovskaya, L.N. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

FLUORIDES/chemical composition; FLUORIDES/refractivity; PHOSPHATE GLASS/chemical composition; PHOSPHATE GLASS/refractivity; DENSITY; FLUORIDES; REFRACTIVITY; QUANTITY RATIO; THERMAL EXPANSION; YOUNG MODULUS

40544 (JHU/APL-TG–1373) **Modifications to the aerotherm charring material thermal response and ablation program (CMA) for carbon ablation analysis: Technical memorandum.** Chan, C.C. Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab. Mar 1989. 97p. Sponsored by U.S. DOE Nuclear Energy. Order Number DE89015140/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Improvements to the Aerotherm Charring Material Thermal Response and Ablation Program (CMA) code have been made to resolve deficiencies that were identified during the Galileo spacecraft reentry/ablation studies for a Venus-Earth-Earth-Gravity-Assist (VEEGA) trajectory. They include several new algorithms to merge the Hunter carbon oxidation subroutine with the mainstream CMA ablation calculations. A surface-temperature criterion is used for switching from the built-in surface thermochemistry tables to the Hunter subroutine. Three methods are available for the CMA user to define the temperature criterion. The first is a constant transition temperature criterion, the second is a constant mass loss parameter (β') criterion that is used to determine the transition temperature, and the last is a search for a temperature that gives the smoothest transition between the Hunter method and the surface thermochemistry tables in CMA (based on the slope differential between both ablation curves). The modifications discussed in this report include use of the Hunter algorithm to compute an ablation threshold temperature of the material. The user may then choose either a constant temperature or use the Hunter algorithm to compute the temperature that corresponds to a negligible mass loss (i.e., no ablation).

40545 (NUREG/CR–5401) **Bond strength of cement borehole plugs in salt.** Akgun, H.; Daemen, J.J.K. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Arizona Univ., Tucson, AZ (USA). Dept. of Mining and Geological Engineering. Jul 1989. 242p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A11/MF A01 - GPO - OSTI.

This report presents results of a series of push-out tests performed on cement plugs emplaced in salt cores. Two types of cement have been tested in salt cores drilled from blocks obtained from a mine in a bedded salt formation. Experiments on rock (salt) bridges provide a reference basis. Test durations vary from minutes to two days. A rather broad range of results was obtained, depending primarily on cement type. Average interface shear strengths, assuming uniform shear stress distributions, range from about 2 to 12 MPa. Peak shear stresses at failure, calculated assuming an elastic exponential shear stress distribution along the interface, are up to more than four times higher. Considerable differences are observed within each test group (standard deviations commonly are 20% and more). Dissolutioning along the interface has been observed in a significant number of samples. It is postulated that this dissolutioning may have been enhanced by dispersion of clay inclusions within the salt. Visible dissolutioning appears to be related to reduced bond strengths. Eighteen samples have been submitted to short-term (up to 34 days) drying and rewetting (for 8 to 28 days) after they had been pushed to failure (slip). Depending upon the reconditioning history, retested strengths range from 18 to 105% of the initial strength, with an average value of about 60%. 79 refs., 42 figs., 19 tabs.

40546 (PNL-SA–15740) **Ultrathinning section techniques for the characterization of brittle materials.** Saenz, N.T. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8907116–1: 22. annual international Metallographic Society meeting, Charlotte, NC (USA), 23 Jul 1989). Order Number DE89015834/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Since the entire technology of petrography has centered around the thirty micrometer thin sections for roughly 100 years, ultra-thin sections, on the order of 1/6 to 1/10 the thickness of conventional sections, constitute a significant advancement in the characterization of brittle materials. With greater emphasis placed on ceramic composites and ceramic materials, a whole new order of optical access to microstructural detail in brittle materials has been made possible with the use of this application. Preparation methods along with microscopy techniques are discussed, and examples of materials examination using this ultrathinning technique are illustrated. 3 refs., 10 figs.

40547 (SAND–88-1519C) **Detonator response measurements with a standardized piezoelectric polymer (PVDF) guage.** Moore, L.M.; Graham, R.A.; Reed, R.P.; Lee, L.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–20: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89008678/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Over the last few years, there has been considerable work in progress to study the features of the piezoelectric polymer film polyvinylidene fluoride (PVDF) under high pressure shock loading. Although full characterization of the material is not complete, it is clear that if the material is prepared with careful attention to the mechanical processing (stretching) and to the electrical processing (electrical poling), that highly reproducible responses can be achieved to shock pressures of over 40 GPa. The purpose of the present study is to characterize the shock-compression response of a 1 mm × 1 mm active area (PVDF) gauge that is subject to standardized gauge-preparation processes. The shock response is studied in both compressed-gas gun, controlled impact loading and in detonator loading configurations. In the present paper, a brief summary of standardization processes will be described followed by a description of the controlled impact loading and the detonator-response measurements. 14 refs., 6 figs., 1 tab.

40548 (SAND–89-0534C) **Valence-band characterization of InGaAs/GaAs and GaAs/GaAsP strained-layer structures.** Jones, E.D.; Biefeld, R.M.; Klem, J.F.; Lyo, S.K.; Osbourn, G.C. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890746–2: 4. international conference on modulated semiconductor structures, Ann Arbor, MI (USA), 17-21 Jul 1989). Order Number DE89015844/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Magnetoluminescence measurements are shown to yield new information about the nonparabolic nature of the valence band in strained-layer structures. Detailed data for InGaAs/GaAs samples are presented and interpreted in terms of a two-band model for the nonparabolicity. 11 refs., 3 figs.

40549 (SAND–89-0857C) **Ion beam analysis of the effects of radiation on the chemical etching of poly(tetrafluorethylene).** Arnold, G.W.; Rye, R.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906155–3: Radiation effects in insulators-5: crystalline oxides and ceramics session, Hamilton (Canada), 19-23 Jun 1989). Order Number DE89015889/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Rutherford backscattering (RBS) and elastic recoil detection (ERD) have been used to characterize the effects of x-ray irradiation on the alkali etching of poly(tetrafluorethylene) (PTFE/Teflon). Etching of an irradiated (20 min Mg($K\alpha$) x-rays) sample produces no RBS evidence of F surface loss (~150 Å depth resolution) while x-ray photoelectron spectroscopy (XPS) measurements (~30 Å sampling depth) show extensive F loss; thus the F loss in irradiated Teflon is limited to depths between 30–150 Å. In sharp contrast, etching of an unirradiated sample produces an RBS measured F loss to depths of 3000–4000 Å. Both the etching depth and the extent of defluorination are shown to be self limiting due to the build-up of reaction products in the pore structure resulting from the deep etching. ERD measurements show a similar H depth distribution, suggested to result from a water reaction during the dissolution of excess Na. An n-hexane rinse leaves a surface Na residue on x-ray irradiated material but sub-surface on unirradiated etched material. 6 refs., 6 figs.

40550 (SAND–89-1060C) **Microcellular polymer foams prepared by thermally-induced phase separation.** Aubert, J.H. Sandia National Labs., Albuquerque, NM (USA). [1989]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8907112–1: SUBWOG-28, Aldermaston (UK), 10-14 Jul 1989). Order Number DE89015490/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Thermally-induced phase separation (TIPS) of polymer solutions is discussed. The process consists of three steps. In the first step, a polymer and solvent are heated above their critical temperature to achieve a homogeneous polymer solution. Next, the solution is quenched in a controlled fashion in order to initiate thermally- induced phase separation, TIPS. Under some circumstances, TIPS can result in the formation of bi-continuous phases, a polymer-rich phase and a solvent-rich phase. Once phase separation has occurred, the solution can be frozen which effectively terminates phase separation. Alternatively with semi-crystalline polymers the solution may form a stable gel after TIPS. In the final step, the solvent is removed by sublimation of the frozen solvent or by liquid extraction of a resulting gel leaving behind a microcellular polymer foam. By controlling the phase separation during the quench, the foam morphology, foam density, and cell size can be varied. 3 refs., 3 figs.

40551 (SAND–89-1061C) **Morphological characterization of microcellular carbon foams.** Aubert, J.H.; Sylwester, A.P. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8907112–2: SUBWOG-28, Aldermaston (UK), 10-14 Jul 1989). Order Number DE89014941/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Low-density, microcellular carbon foams have been prepared by the high temperature degradation of polyacrylonitrile (PAN) foams in an inert atmosphere. The PAN foams are first prepared by controlled phase separation of PAN solutions followed by solvent removal. Some possible applications for low-density, microcellular carbon foams are: catalyst supports, adsorbents, porous electrodes, high temperature structural insulation, and in the fabrication of inertial confinement fusion targets. To effectively design and use these carbon foams, it is necessary to characterize their morphology. In this paper, we describe two techniques which are well suited to characterize microcellular carbon foam morphologies. 3 refs., 1 fig.

40552 (SAND–89-1756C) **Radiation-oxidation of polymers.** Clough, R.L.; Gillen, K.T. Sandia National Labs., Albuquerque, NM (USA). 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8907108–1: IAEA advisory group meeting on radiation degradation of polymers, Takasaki (Japan), 17-20 Jul 1989). Order Number DE89014135/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Radiation effects on polymers in the presence of air are characterized by complicated phenomena such as dose-rate effects and post-irradiation degradation. Most applications of polymeric materials in radiation environments involve air atmospheres. Taking account of oxidation effects and time-dependent phenomena is a necessity for understanding materials changes which occur during aging, and for dealing with issues of materials lifetime prediction, aging monitoring, materials selection, and material stabilization. Time-dependent radiation-degradation effects can be understood mechanistically in terms of: (1) features of the free radical chain-reaction chemistry underlying the oxidation, and (2) oxygen diffusion effects. A profiling technique has been developed to study heterogeneous degradation resulting from oxygen diffusion, and kinetic schemes have been developed to allow long-term aging predictions from short-term high-dose-rate experiments. These methodologies have been successfully applied for predicting degradation rates of a number of different materials under ambient nuclear environments. Low molecular weight additives which act either as free-radical scavengers or else as energy-scavengers are effective as stabilizers in radiation-oxidation environments. Non-radical oxidation mechanisms, involving species such as ozone, can also be important in the radiation-oxidation of polymers. 14 refs., 13 figs.

40553 (SAND–89-1828C) **Pressure studies of deep levels in semiconductors.** Samara, G.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890798–3: AIRAPT and EHPRG international high pressure science and technology conference, Paderborn (Germany, F.R.), 17-21 Jul 1989). Order Number DE89015851/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The effects of pressure on the energetics and kinetics of electron emission and capture processes by several important deep levels in Si are discussed. The results yield the first quantitative measures of the breathing mode lattice relaxations accompanying these processes. 2 refs., 1 fig.

40554 (UCID–21724) **Enthalpies of formation of silica aerogel materials.** Fischer, J.W.; Miller, D.G. Lawrence Livermore National Lab., CA (USA). 19 Jun 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013974/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed a method by which we can estimate the heats of formation of various silica aerogel formulations that are formed by the polymerization of tetramethoxysilane. This document will summarize the results of our efforts and will provide a formula by which the enthalpies of formation can be calculated for any given aerogel formulation if the mass fractions of hydrogen and carbon are known. In order to proceed with our development, it was necessary to assume one of several mutually consistent chemical models that have been proposed to represent the silica aerogels that are formed by the polymerization process. For convenience, we assumed the aerogel materials to be pure SiO_2 in their interiors, with the surface silicon atoms singly bonded to two interior oxygen atoms and then either doubly bonded to a surface oxygen atom or else singly bonded to two methoxy groups, to two hydroxy groups, or to one of each. 2 tabs.

40555 (UCRL–21194) **A study of crack initiation threshold in the ductile micro-machining and grinding of glass: Final report covering the period June 21, 1988–October 31, 1988.** Cheng, Weili; Finnie, I. Lawrence Livermore National Lab., CA (USA). 1988. 27p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015726/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Contains the report title by Weii Cheng and Iain Finnie: A mechanism for sub-surface median crack initiation in glass during indenting and scribing.

The initiation of sub-surface median cracks in glass during indenting and scribing is studied. It is shown that the zone of intense deformation under the tool introduces a weak singularity which may have a strong influence on crack initiation. When combined with a crack nucleus, which needs only be of the order of the dimensions of the glass network, the weak singularity allows the threshold load for median cracking to be estimated. This estimate is shown to be in good agreement with experimental observations. The analysis explains the sudden transition from brittle to ductile behavior in glass and also provides a possible explanation for the origin of the elusive "Griffith flaws." 19 refs., 8 figs.

40556 Deuterated L-arginine phosphate. Eimerl, D. (Lawrence Livermore National Lab., Livermore, CA (US)); Velsko, S.; Davis, L.; Wang, F.; Loiacono, G.; Kennedy, G. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

Deuterated l-arginine phosphate (d-LAP) is a new nonlinear optical material which is being developed for harmonic generation of high-power lasers. It is a member of a larger class of organic material which is being studied as a potential replacement for KDP in lasers for inertial confinement fusion research. Both the undeuterated form (LAP) and the deuterated form (d-LAP) grow easily from aqueous solution, and the authors have demonstrated the growth of large crystals of high optical quality. In particular, crystals of d-LAP are now available with volumes in excess of 100 cm^3. Both LAP and d-LAP are phase-matchable for all nonlinear processes where KDP is phase-matchable, and, with the possible exception of fourth harmonic generation to 266 nm, they are generally substantially more efficient than KDP. (They are also substantially more efficient than barium borate.) These crystals are more nonlinear than KDP, and, therefore, they achieve higher efficiency with a smaller crystal volume and expense.

40557 Thermodynamic study of silane-hydrogen chemical system. Patel, R.I. (3M Co., St. Paul, MN (US)). vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

The thermodynamic calculations of chemical equilibrium compositions of various species were performed for silane-hydrogen system at different temperatures [500-600], pressures [0.01 - 10 Torr], and mixing ratios [various silance fractions]. The effect of dopant impurities such as diborane and phosphine on equilibrium concentration profiles of various gaseous, ionic, and condensed species was also investigated. These data are very useful in understanding the deposition chemistry of silane chemical systems and a valuable aid in optimization studies.

40558 Properties of intrinsic a-Si films deposited from higher order silanes by chemical vapor deposition. Rocheleau, R.E. (Univ. of Delaware, Newark, DE (US)); Hegedus; Baron, B.N. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

Amorphous silicon films have been deposited by chemical vapor deposition using disilane at temperatures between 360 and 525°C at growth rates up to 50 A/s. Intrinsic films have the following properties: σ_{ph} less than 5×10^{-6} $(\Omega\text{-cm})^{-1}$; σ_d less than 5×10^{-11} $(\Omega\text{-cm})^{-1}$ with E_a = 0.7 to 0.8 eV; diffusion length around 0.1 μm; Urbach energy 48 to 55 meV; and mid-gap density of states greater than 5×10^{16} cm^{-3} eV^{-1}. Boron compensation improved collection efficiency by lowering the mid-gap density of states, not by improving the μtau product. Pin cells with efficiencies of 4% and J_{sc} = 10.9 mA/cm^2 (87.5 mW ELH) were fabricated.

40559 Amorphous silicon films and solar cells prepared by mercury-sensitized photo-CVD of silane and disilane. Delahoy, A.E. (Chronar Corp., Princeton, NJ (US)); Doele, B.; Ellis, F.B. Jr.; Ramaprasad, K.R.; Tonon, T.; VanDine, J. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

The low temperature deposition of a-Si:H films and devices by mercury-sensitized photo-decomposition of silanes is described. The problem of window deposition is ameliorated by the use of a perfluoropolyether coating to give deposition rates of 0.3 A s^{-1}. Highly photosensitive undoped layers can be produced. These films exhibit many properties in common with glow discharge including thermal quenching of photoconductivity between 125-200 K and the Staebler-Wronski effect. A wide gap silicon carbide p layer is described, and is usefully employed in p-i-n structures to give 6% efficient solar cells. SIMS analysis of these devices shows that it is possible to achieve sharp p-i interfaces in a single chamber reactor. Deposition rates greater than 2 A s^{-1} have recently been achieved.

40560 Dual-chamber plasma deposition of A-Si:H solar cells at high rates using disilane. Rajeswaran, G. (Brookhaven National Lab., Upton, NY (US)); Vanier, P.E.; Corderman, R.R.; Kampas, F.J. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421–: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

The use of a separated chamber deposition system for the fabrication of a-Si:H solar cells from disilane at high deposition rates results in a substantial improvement in short circuit current compared to that obtained from a single-chamber system. The spectral responses of cells fabricated in the dual-chamber mode are compared to those made in the single-chamber mode. The results are interpreted by assuming that the rate of removal of boron contaminants from the chamber is independent of deposition rate.

40561 Optical quality high-strength glass laser slabs. Marion, J.E. (Lawrence Livermore National Lab., Livermore, CA (US)). vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

The power output potential for high-average-power laser slabs has been increased substantially using three techniques: 1) improving the composition of the base glass for superior thermomechanical properties; 2) treatment of the surface of the laser slabs to decrease the depth of the flaws originating from optical fabrication; and 3) reducing the liability from the remaining flaws by placing them in a compressive stress. The authors have demonstrated each of these methods for improving power output potential in full scale glass slab tests in a laser head. In these tests, optical quality slabs

(32 X 10 X 1.5 cm^3) were pumped to failure; a comparison between the flashlamp power required to fracture the improved slabs and the power required to fracture optical quality, unimproved slabs permits an assessment of the increase in power output potential.

40562 Comparison of low temperature photoluminescence of bulk MBE grown AlGaAs and GaAs using a graphite generated dimer versus a standard tetramer arsenic group-V source. Brennan, T.M. (Sandia National Labs., Albuquerque, NM (US)); Hammons, B.E.; Smith, M.C.; Jones, E.D. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229–: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

The carbon concentrations in GaAs and AlGaAs grown by Molecular Beam Epitaxy (MBE) have been studied when a graphite generated dimeric arsenic species and a standard tetramer arsenic species are used as the group-V source. Photoluminescence and Van der Pauw-Hall measurements have been made to examine the material quality in reference to which arsenic species is used for film growth. Results indicate that a graphite crucible arrangement for the thermal cracking of As_4 produces significant carbon contamination and is unacceptable for the MBE growth of GaAs and AlGaAs.

40563 The influence of current stressing on the structure of Ag contacts to GaAs. Lilienthal-Weber, Z. (Lawrence Berkeley Lab., Berkeley, CA (US)); Newman, N.; Jou, C.; Washburn, J.; Weber, E.R.; Miret-Goutier, A.; Spicer, W.E. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229–: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

The stability of Ag Schottky contacts on GaAs after voltage and current stressing has been investigated. The barrier height and its stability against voltage and current stressing were found to depend on the diode fabrication method (metal deposition onto either air-exposed or ultra-high vacuum cleaved (UHV) substrates). The barrier height of Ag diodes formed on air exposed surfaces is 0.96 eV, and a significant decrease of 70 meV was found upon exposure to voltage and current stressing. In contrast, the barrier height Ag diode formed on UHV cleaved samples is 0.89 eV, and no significant change was found upon exposure to stressing. The structure of the contacts was studied by transmission electron microscopy. Ag deposited on UHV cleaved substrates shows an epitaxial relationship to GaAs and atomically flat interfaces. Exposure to air before the metal deposition led to nonuniform reactions and compound formation at the interface as compared to UHV samples.

40564 A TEM study of Rhodium on GaAs. Packer, S.L. (Hewlett Packard, San Diego, CA (US)); Gronsky, R. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229–: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

Reaction between Rhodium films and n-type GaAs in the temperature range of 300^0 to 700^{0}C has been examined using the TEM to look at the interface and phases present. The reaction between Rh and GaAs produces a layered structure of Rh/RhGa/$RhAs_2$/GaAs based on RBS and TEM. Above 300^{0}C, the RhGa phase has an orientation relationship of [011]RhGa//[100]GaAs. In cross-section, an interpenetrated layered structure was observed with equiaxed RhGa above columnar grains of $RhAs_2$. Rhodium is the moving species as suggested by voids at the Rh/reacted layer interface. The interface between the reacted layer and GaAs was smooth at 450^0 and 20 minutes of annealing but showed 10 nm periodic penetrations when annealed at 400^0 for 90 minutes. Interface roughness may influence the low barrier height reported for the Rh Schottky diode annealed at 400^0.

40565 X-ray diffraction study of a thin GaAs film on Si(100). Bommannavar, A.S. (Oak Ridge National Lab., Oak Ridge, TN (US)); Sparks, C.J.; Habenschuss, A.; Ice, G.E.; Dhere, A.; Morkoc, H.; Zabel, H. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229–: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

A 900 A single crystalline GaAs film deposited by molecular beam epitaxy (MBE) on a silicon crystal cut 4.1^0 from (001) surface was characterized with X-ray diffraction measurements of the mosaic spread, particle size and strain distribution, and lattice parameter. The GaAs film had a larger mosaic spread in the direction of the steps of the silicon surface and coherent particle sizes of about 900 A compared to the estimated film thickness of approximately 1000 A. Superlattice reflections gave an ordered domain size of about 330 A. There is a residual strain gradient in the film which is nearly linear with the lattice constant differing by about 0.044 A between the surface of the film and its interface with the silicon substrate. Lattice parameter measurements indicate a small expansion of 0.13% perpendicular to the plane of the film.

40566 Interfacial reactions between Ni and GaAs. Lin, J.C. (Univ. of Wisconsin-Madison, Madison, WI (US)); Zheng, X.Y.; Hsieh, K.C.; Yang, Y.A. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229–: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

Interfacial reactions between Ni and GaAs have been studied using bulk diffusion couples of Ni(-0.5mm thick)/GaAs and thin-film Ni(–40nm) on GaAs (100) in addition to phase diagram determination at 600^{0}C. On the basis of the phase diagram and the bulk diffusion couples, the ternary phase which forms first in the thin-film couples is Ni_3GaAs. Thin-film studies show that the epitaxial growth of equilibrium contact phases, i.e., NiAs and β-GaNi, on a GaAs (100) substrate is possible.

40567 Pulsed laser crystallization of Ge_xSi_{1-x} alloy films on Si(100) substrates. Abelson, J.R. (Lawrence Livermore National Lab., Livermore, CA (US)); Sigmon, T.W.; Weiner, K.; Kim, K.B. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229–: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

The authors demonstrate the fabrication of high quality Ge_xSi_{1-x} heteroepitaxial alloy layers of Si(100) substrates by pulsed laser melting of a-Ge/Si(100) layered structures. First, 50-200A of germanium are evaporated onto a chemically cleaned silicon wafer. Next, an excimer laser pulse is used to melt the sample surface to a depth of 200-2500A. Finally, the melt solidifies in 20-100ns producing a heteroepitaxial alloy layer. By varying the thickness of the evaporated Ge film and the laser energy, alloys of 500-1500A thickness and Ge fraction chi=3-20% are obtained. The crystallinity of the layer and interface are found to be excellent as evaluated by Rutherford Backscattering Spectrometry (RBS), ion channeling, and high resolution cross sectional TEM. This technique for producing Ge_xSi_{1-x} alloy layers is insensitive to minor levels of contamination because the original Ge/Si interface is melted through during the laser processing.

40568 Buried silicide synthesis and strain in cobalt-implanted silicon. Barbour, J.C. (Sandia National Labs., Albuquerque, NM (US)); Picraux, S.T.; Doyle, B.L. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229–: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

Silicon (001) substrates were implanted with 350 keV Co at room temperature and 450^{0}C with fluence of from 1x10^{17} Co/cm^2 to 6x10^{17} Co/cm^2. All samples were annealed at 1000^{0}C in order to form the $CoSi_2$ phase. Concentration profiles were determined with Rutherford backscattering spectrometry (RBS), and the associated strain profiles were analyzed with double-crystal X-ray rocking curve measurements. Ion channeling was also used to characterize the silicide formation and crystal quality. An implantation of 6x10^{17} Co/cm^2 at 450^{0}C forms a single-crystal $CoSi_2$ layer while lower fluences do not. A continuous, buried $CoSi_2$ single-crystal layer is formed for the 3x10^{17} Co/cm^2 sample implanted at 450^{0}C and annealed at 1000^{0}C. The continuous $CoSi_2$ layer is thicker than the critical layer thickness for a fully coherent film, and therefore the

layer partially relaxes. A relaxation of 50% of the fully coherent value is observed for this buried silicide system.

40569 Light-induced metastable defects in a-Si. Stutzman, M. (Xerox Palo Alto Research Center, Palo Alto, CA (US)); Jackson, W.B.; Tsai, C.C. vp. of Materials issues in applications of amorphous silicon technology. Adler, D.; Madan, A.; Thompson, M.J. Materials Research Society, Pittsburgh, PA (1985). (CONF-850421--: 2. spring meeting of the Materials Research Society, San Francisco, CA (USA), 15-18 Apr 1985).

The dependence of the creation and the annealing of metastable dangling bonds in hydrogenated amorphous silicon on various material parameters is discussed in the context of a recently proposed model. After a brief review of the kinetic behaviour governing defect creation and annealing in undoped a-Si:H, a number of special cases is analyzed: the influence of alloying with O, N, C, and Ge, changes introduced by doping and compensation, and the role of mechanical stress. Finally, possibilities to increase the stability of a-Si:H based devices are examined.

40570 Crystallization behavior of a fully simulated West Valley borosilicate glass. Joseph, I. (Institute of Glass Science and Engineering, New York State College of Ceramics, Alfred Univ., Alfred, NY (US)); Mathur, A.; Capozzi, C.; Sehgal, J.; Butts, D.; McPherson, D.; Pye, L.D.; Eisenstatt, L. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201--: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

The crystallization behavior of a fully simulated West Valley reference borosilicate glass was studied. The studies were conducted on fully oxidized and partially reduced samples of the glass. Glass samples were heat treated isothermally over the temperature range of 500-1000^{0}C for time periods ranging from 1 to 384 h. The main crystalline phase observed in the heat treated samples were spinel, acmite, and cerium-thorium oxide. The volume percent of crystals in heat treated samples were determined by image analysis in conjunction with optical microscopy. Based on these results, quantitative time-temperature-transformation diagrams were constructed.

40571 Energy loss rates for light holes in InGaAs/GaAs strained-layer single quantum wells. Smith, M.C. (Sandia National Labs., Albuquerque, NM (US)); Jones, E.D.; Fritz, I.J.; Drummond, T.J.; Zipperian, T.E.; Schirber, J.E. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229--: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

Energy relaxation rates for light holes in InGaAs/GaAs strained layer quantum wells are measured. Two techniques were used to measure light hole temperatures as a function of power dissipated in the hole gas. For $T_h < 20K$, Shubnikov-de Haas oscillations were used and for $T_h < 20K$, a photoluminescence technique was employed.

40572 TEM and TED studies of ordering in GaInP. Goral, J.P. (Solar Energy Research Institute, Golden, CO (US)); Al-Jassim, M.M.; Olson, J.M.; Kibbler, A. vp. of Epitaxy of semiconductor layered structures. Tung, R.T.; Dawson, L.R.; Gunshor, R.L Materials Research Society, Pittsburgh, PA (1988). (CONF-8711229--: Epitaxy of semiconductor layered structures symposium, Boston, MA (USA), 30 Nov - 4 dec 1987).

Transmission electron microscopy (TEM) and transmission electron diffraction (TED) studies have shown the presence of long range CuPt-type cationic ordering in GaInP grown by MOCVD on (001) GaAs. Domains regions (on order of 10^4nm^2) exhibit a double periodicity along the [111] and [111] directions.

40 CHEMISTRY

Refer also to citation(s) 40340, 40684

4001 Analytical and Separations Chemistry

Refer also to citation(s) 39830, 39913, 39923, 39924, 39925, 39927, 40118, 40517, 40526, 40533, 40616, 40666, 40705, 40776, 40789, 40865, 40934, 41021, 41056, 41057, 41058, 41059, 41061, 41064, 41065, 41067, 41068, 41073

40573 (CRN-PN–87-33) **Radiation dosimetry by neutron or X ray fluorescence activation of residual silver in ionographic emulsions.** Heilmann, C. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1987. 100p. (In French). Order Number DE89903289/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

A global measuring technique which is sensitive enough to detect small silver contents in films for dosimetry applications is presented. The applications studied are neutron dosimetry by measuring residual silver due to recoil protons in developed emulsions and high dose dosimetry by the detection of photolytic silver in fixed emulsions. An individual fast neutron dosimeter which can be used in radiation protection was developed, along with an automatic data analysis and readout system. Application of this technique to the measurement of high radiation doses (100 to 1 million Gy) via the measurement of photolytic silver in fixed, but undeveloped, emulsions confirms the usefulness of the method.

40574 (DOE-RW–88.108) **Lead slowing down spectrometer: initial evaluation of applicability to the quality checking of intermediate and high level waste.** Armitage, B.H. Department of the Environment, London (UK). 1988. 17p. (AERE-R–13048;ILWRP–87-P16). Order Number DE89632460/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Lead slowing down spectrometers in conjunction with intense pulsed neutron sources are able to measure neutron cross-section with small amounts of sample material. An initial assessment has been made of its potential for the quality checking of drummed waste. The assessment has been made with the help of the Monte-Carlo computer code MCNP which was used to model a lead slowing down spectrometer. The results indicate that the instrument is unsuitable for the quality checking of either vitrified high level waste or grouted intermediate level waste, but it may be suitable for unencapsulated metallic waste. (author).

40575 (ETDE-mf–9794744) **Comparative analyses concerning the detection and distribution of lead and cadmium in cow kidneys applying electrothermal atomic absorption spectrometry and solid matter analyses by ZEEMAN-AAS.** Luecker, E. Giessen Univ. (Germany, F.R.). Fachbereich Veterinaermedizin und Tierzucht. 27 Nov 1987. 224p. (In German). Order Number DE89794744/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; NTIS (US Sales Only), PC A10/MF A01.

The correctness and precision of the lead and cadmium determination in the kidneys of cattle were tested by means of two methods of solids analysis of the atomic absorption spectroscopy (ZEEMAN-AAS and D_2AAS) and by means of the conventional wet chemical analysis method. Caused by the heterogeneous distribution of lead and cadmium in the kidney, none of these three methods was suitable with regard to correctness, precision and reproducibility of the measured results for the determination of heavy metal content in the whole organ. For the measurement in renal cortex homogenisates, which always contained the highest Pb and Cd contents, comparable results were obtained. Within the tissue of the renal cortex, a sufficient homogeneity of the element distribution is given by which a high degree of correctness and precision is guaranteed for the solids analysis as well as the wet chemical method. (ECB).

40576 (FRNC-TH–3466) **Ionic flotation of complexing oxyanions. Thermodynamics of uranyl complexation in a sulfuric medium. Definition of selectivity conditions of the process.** Bouzat, G. Institut National Polytechnique, 54 - Nancy (France). 1987. 154p. (In FR, EN). Order Number DE89903249/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Oxyanion ionic flotation process with dodecylamine hydrochloride as collector is studied by investigation of flotation and filtration recovery curves, suspension turbidity, conductimetric measurements, and solubility of ionic species. The process is controlled by chemical reactions of precipitation and by adsorption of surfactant

confering hydrophobic or hydrophilic surface properties to the solid phase respectively when one or two monolayers of surfactant are successively adsorbed. Equilibrium constants (in terms of activity) of the uranium (VI) complexation with sulphate oxyanions are calculated through Raman spectroscopic study of uranyl sulphate aqueous solutions. The complexation results in a shift of the symmetrical stretching vibration band of UO_2 to low wavenumbers and an increase of their cross section. The solubility curves of ionic species in the precipitation of uranyl -sulphate complexes by dodecylamine hydrochloride are modelled. The knowledge of solubility products, activity coefficients of the species and critical micellar concentration of the surfactant allow the modelling of flotation recovery curves. Temperature and collector structure modifications are studied in terms of optimization parameters and uranium extraction of mine drainage water is processed. Residual concentration of surfactant is considerably lowered by adsorption on montmorillonite.

40577 (IGCAR–78) **Spectrochemical analysis of alloy-800.** Srinivasan, V.; Krishna Prabhu, R.; Mahalingam, T.R. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1986. 16p. Order Number DE89630797/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An emission spectrographic method for the determination of seven elements in alloy-800 is described. The metal sample is converted to oxide and a 10 per cent carrier mixture (AgCl+LiF+C) is used for the determination of Al, Co, Cu, Mn, Mo and V. 45mg of this (sample + carrier) mixture is taken in a carrier distillation electrode and excited in a d.c. arc. The concentration ranges of the elements determined varies between 200ppm and 0.8 per cent and the coefficient of variation has been found to be around 15 per cent. For the determination of titanium, the sample oxide is glued to the flat tops of a pair of graphite electrodes and excited with a.c. spark. The concentration range covered is 0.35 to 2.0 per cent and the coefficient of variation is found to be $\pm$ 3 per cent. (author). 5 figs., 4 tabs.

40578 (INIS-mf–11459, pp. 31) **Gamma spectrometric determination of U, Th, Ra and K in volcanic rocks at uranium-bearing district of Macusani, Puno.** Wong, M. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Quispe, R. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos*. Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Short communication.

40579 (INIS-mf–11495) **Fifth Australian conference on nuclear techniques of analysis : proceedings.** Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. 266p. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The conference was divided into sessions on the following topics : environmental applications, archaeometry, instrumentation, materials science, industrial applications, surfaces, bioscience applications, geoscience and mining applications.

40580 (INIS-mf–11495, pp. 1-4) **Application of nuclear techniques of analysis to environmental problems.** Ritchie, A.I.M. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings*. Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Environmental problems cover a wide scope from the determination of contaminant concentrations in soil and water, through rates of chemical reactions to uptake and deposition of toxic materials in animals. Nuclear techniques of analysis provide powerful and often unique tools in tackling problems.

40581 (INIS-mf–11495, pp. 5) **Fine particle aerosol monitoring in an urban environment.** Clayton, E. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Shortland, J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings*. Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Abstract only.

40582 (INIS-mf–11495, pp. 6-9) **Chlorine-36 measurement program at the A.N.U.** Davie, R.F. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Bird, J.R.; Calf, G.E.; Topham, S.; Fifield, L.K.; Ophel, T.R.; Allison, G.B.; Chivas, A.R. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings*. Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The chlorine-36 measurement program is described. This program uses the technique of accelerator mass spectrometry to measure $^{36}Cl/Cl$ ratios in environmental samples down to levels as low as a few parts in 10^{15}.

40583 (INIS-mf–11495, pp. 14-17) **Future of neutron activation analysis - instrumental and radiochemical.** Fardy, J.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Energy Chemistry). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings*. Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

This review uses publications and papers presented at conferences over the last two years to examine current usage and to predict future trends for both instrumental and radiochemical neutron activation analyses. Speed of analysis and lower limits of detection have been and will continue to be important criteria. The increased use of short-lived radionuclides dominates instrumental analysis, while rapid adsorption and precipitation techniques form the basis of the radiochemical analysis. Finally, the future of neutron activation analysis is briefly reviewed with the advent of inductively coupled plasma mass spectrometry as a sensitive, multi-element, trace analytical technique.

40584 (INIS-mf–11495, pp. 21-23) **Ceramic production in the Bronze age : analysis of pottery from Japan.** Knapp, A.B. (Sydney Univ. (Australia)); Wright, R.V.S.; Grave, P.; Duerden, P. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings*. Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Two styles of Bronze Age pottery from Jordan were analysed by both PIXE-PIGME and NAA, to throw light on their affinities with local clays. Rotated principal components gave readily interpretable results and demonstrated that the results from PIXE-PIGME and NAA are essentially the same.

40585 (INIS-mf–11495, pp. 24-26) **Uranium series dating of diprotodon teeth from archaeological sites on the Liverpool plains.** Fethney, J. (Powerhouse Museum Sydney (Australia)); Roman, D.; Wright, R.V.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings*. Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

In an attempt to test unexpected Holocene radiocarbon dates for archaeological deposits containing tooth fragments of Diprotodon (and other megafauna), uranium series dates were obtained for the teeth. All proved 2 to 4 times older than radiocarbon ages for the deposits. This apparently excess age included dates on control species still extant and found associated with the megafauna. The causes of apparent contamination are discussed.

40586 (INIS-mf–11495, pp. 28-29) **Fast neutron production using a gas target on SNIF.** Dytlewski, N. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Walsh, R.; Cohen, D.; Bolderman, J.; Croal, A.; Thorpe, K.; Fallon, J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The Standard Neutron Irradiation Facility SNIF at Lucas Heights comprises several beamlines on the 3MV Van de Graaff accelerator dedicated to producing neutron beams with well characterised energies and fluxes. Monoenergetic and broad spectrum neutron beams with energies from tens of keV to many MeV can be produced using a variety of nuclear reactions. The addition of a deuterium gas target to SNIF has enabled neutron beams with fluxes of approximately 3 x 10^8 neutrons/cm^2/sec and with energies up to 6 MeV to be produced. Current applications using high fast neutron flux include irradiation of biological material to study neutron induced damage in DNA and mutagenesis of the genes.

40587 (INIS-mf–11495, pp. 30-32) **Development of heavy ion molecular orbital induced X-ray emission as a new microanalytical technique.** Ryan, C.G. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Sie, S.H.; Suter, G.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The formation of atomic vacancies via the promotion of electrons into molecular orbitals during quasi-adiabatic ion-atom collisions, can lead to high X-ray production cross-sections for those target species with energy levels nearly matching those of the projectile ion. The selectivity and sensitivity of this mechanism was investigated together with its potential application to the microanalysis of trace Au, platinum group elements, and rare-earth elements using beams of ^{28}Si and ^{63}Cu ions from the HIAF microprobe.

40588 (INIS-mf–11495, pp. 37-39) **Gamma-ray catalog.** Bird, J.R. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Particle induced gamma-ray emission (PIGME) is potentially an absolute analytical technique. However, gamma-ray yield measurements at different laboratories often differ by a factor of two or more even although individual measurements can be used for isotope determination to 1% precision or better. The most important factor is the incident energy since yields often depend on third or higher powers of energy. Yield measurements should therefore be carried out in conjunction with precise energy calibrations. Measurements have been made at 45 deg, 55 deg, 90 deg, or 135 deg to the incident beam direction but, for most isotopes, yields should be close to isotropic and anistropy is unlikely to be responsible for the differences in reported yields. The detector efficiency can be accurately determined for gamma-rays up to 1.5 MeV which includes the majority of cases used in sample analysis. Ion dose can also be determined with adequate accuracy.

40589 (INIS-mf–11495, pp. 40-42) **Assay of spontaneous fissioning isotopes by neutron coincidence counting.** Dytlewski, N. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The accurate assay of plutonium in waste material from reprocessing plants is an important requirement for the IAEA safeguards verification programme. A new hybrid neutron coincidence counter which combines the features of the High Level Neutron Coincidence Counter (HLNCC) and the Liquid Scintillator Neutron Coincidence Counter (LSNCC) can correct for neutron multiplication without reference to any plutonium containing standards.

40590 (INIS-mf–11495, pp. 51-52) **Comparison of analysis of nitrogen by RBS and nuclear profiling.** Kenny, M.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Materials Science and Technology); Wielunski, L.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The sensitivity obtained in Ion Beam Analysis is dependent on the element being profiled and the technique used. Nitrogen may be profiled by either Rutherford Backscattering (RBS) or Nuclear Reaction Analysis (NRA). A comparison of the two methods has been made for both ^{14}N and ^{15}N. The NRA technique is considerably more sensitive, but involves the use of deuteron beams in the case of ^{14}N and is only applicable in the case of ^{15}N when the separated isotope is used, as its natural abundance (0.36%) is too low.

40591 (INIS-mf–11495, pp. 61-63) **PIXE spectrum treatment and quantitative trace element microanalysis.** Ryan, C.G. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Cousens, D.R.; Sie, S.H.; Griffin, W.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The accuracy and reliability of PIXE trace element microanalysis of mineralogical specimens was enhanced by the appropriate treatment of the X-ray spectra. Peak tailing contributions were stripped and a robust continuum background approximation was developed. Up to 27 lines for an element were included in spectrum fitting. Experimental line intensity ratios were measured for 51 elements and used to adjust database values.

40592 (INIS-mf–11495, pp. 70-72) **High resolution two stage proton microprobe.** Moloney, G.R. (Melbourne Univ., Parkville (Australia). School of Physics); Legge, G.J.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A new microprobe at Melbourne, MPII, has been designed and is currently under construction. The new probe is intended primarily for developmental work. The optical design criteria and properties of the system are presented. Also presented are the results of an investigation of the magnetic field profiles of the MP quadrupoles. Contamination of the quadrupole field by higher order multipole fields, producing parasitic aberration of the image, is shown. A procedure for correction of the most significant contaminants is also suggested.

40593 (INIS-mf–11495, pp. 73-75) **Thick source alpha counting : increase in count-rate after fusion in lithium borate.** Hutton, J.T. (Adelaide Univ. (Australia). Dept. of Physics). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Thick source alpha counting is a simple convenient method of measuring the radioactivity due to the natural low levels of thorium and uranium in rocks, soils, sediments, etc. If a sample is fused at

1000 deg C with lithium borate to form a glass (sample to flux ratio of 1:1) all the radon and polonium in the sample are lost by volatization. The radon that grows back, however, is all retained in the glass and an accurate measure of the increase in count-rate with time can be made. After 20 days (5 times half-life of ^{222}Rn) the increase in count-rate should be 1.4 times the count-rate after 2 hours which can be calculated as due to the uranium series isotopes heavier than ^{222}Rn. After 2 years the increase due to ^{210}Po can be measured and compared with the increase due to ^{222}Rn.

40594 (INIS-mf–11495, pp. 76-78) **Low level measurements of potassium, thorium and uranium by means of scintillometry in the field.** Prescott, J.R. (Adelaide Univ. (Australia). Dept. of Physics); Hutton, J.T. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A URTEC UG140 portable gamma ray spectrometer and an externally housed low background sodium iodide crystal have been used in many sites at widely differing localities to measure potassium, thorium and uranium in the field. In most cases it was necessary to count for 1000 seconds for each element. The scintillometer results have been compared with XRF results and despite the low levels, the average ratio of XRF to scintillometer is unity for the three elements at five localities.

40595 (INIS-mf–11495, pp. 111-113) **Hydrogen profiling with the AINSE XYZ manipulator.** Cohen, D.D. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia)); Katsaros, A.; Rose, A. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The Elastic Recoil Detection (ERD) technique, using a low energy (<3MeV) ^{4}He beam can be used to simultaneously profile all hydrogen isotopes, H, D, and T, with sensitivities as high as 0.1 atom%. The ERD technique is similar to RBS, in both cases an elastic scattering event is essential. Instead of detecting the incident ions scattered from the target atoms, we detect the light recoiling nuclei (H) after being hit by the heavier incident ions (He). This can only be done in the forward direction. Unfortunately other heavy incident ions (He) are also elastically scattered in the direction of the recoil hydrogen and an absorber foil of appropriate thickness must be placed in front of the detector to stop these but allow the lighter recoiled target atoms through. This limits the ERD technique to near surface (<1 μm) regions and degrades its depth resolution. It is therefore necessary to design experiments to optimise the recoil hydrogen energy.

40596 (INIS-mf–11495, pp. 133-135) **On-stream analysis of iron ore using pair production.** Holmes, R.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)); Downie, S.P. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

An on-stream iron ore analyser has been developed in collaboration with Hamersley Iron for determining the iron content of both lump and fines on conveyor belts. The analyser, which is based on pair production, can be mounted under existing conveyor belts with minimal modification to the conveyor structure, and the presence of steel cables in the belt does not interfere with the measurements once the analyser has been calibrated correctly. Typically, the rms deviation between on-stream analyser and chemical analyses is better than 0.5% Fe. Mineral Control Instrumentation in Adelaide is now producing the analyser commercially.

40597 (INIS-mf–11495, pp. 136-139) **Ion beams in industry.** Saint, A. (Melbourne Univ., Parkville (Australia). School of Physics). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

This paper presents some work done at A.E.R.E. Harwell into the uses of ion implantation and ion beam analysis applied to commercial problems. Both the principles and applications of these techniques are discussed.

40598 (INIS-mf–11495, pp. 140-141) **Ion beam analysis of polymer films.** Bird, J.R. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Cohen, D.D.; Kannemeyer, C. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Exploratory measurements have been made using the Lucas Heights 3 MV Van de Graaff accelerator to apply ion beam analysis techniques to the determination of elemental composition and depth profiles of polymer films on metal substrates. A sample of TiO_2 mixed with 20% graphite was used as a reference and various elemental samples were used to calibrate the equipment. Proton and alpha beams were used for backscattering, elastic recoil and PIXE measurements.

40599 (INIS-mf–11495, pp. 142-144) **Instrumental neutron activation analysis of a high grade rare earth element ore deposit.** Lottermoser, B.G. (Newcastle Univ. (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Instrumental neutron activation analyses of geological material comprising elevated contents of REE, P, U, Th, Ba, Sr, Fe and Mn are documented from a deeply weathered carbonatite intrusion. The unusual geochemical composition of the samples resulted in high deadtimes, a Bremsstrahlung spectrum (^{32}P) and REE fission products of ^{235}U. These analytical problems required short irradiation periods, planar and coaxial detectors, an appropriate counting sequence, beta absorbers between samples and detector assembly and numerical corrections for REE fission products.

40600 (INIS-mf–11495, pp. 169-171) **Bulk analysis of silver, lead and zinc in drill cores.** Ellis, W.K. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)); Sowerby, B.D.; Rainey, P.T.; Dekker, D.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A bulk analyser is being developed to determine the silver, lead and zinc contents of unsplit drill cores. Laboratory work carried out at Lucas Heights Research Laboratories has shown that the most favourable bulk analysis techniques for the elements silver, lead and zinc are neutron activation, gamma-ray scattering and neutron inelastic scattering respectively. Three measurement stations would be needed. However the same annular borecore holder would be used for all three measurements, so that the operator needs to load the sample only once. Results on a large number of crushed Hilton borecores show that lead can be determined to within 0.7 wt%. Preliminary results indicate that Ag and Zn can be determined to within about 20 ppm and 0.7 wt% respectively. A bulk analyzer based on the above techniques would analyse about 6 samples per hour.

40601 (INIS-mf–11495, pp. 172-174) **On-line determination of moisture in coke on conveyor belts.** Sowerby, B.D. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)); Millen, M.J.; Rafter, P.T. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov

1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A fast neutron and γ-ray transmission technique is being developed for the on-line analysis of moisture. Calculations show that the technique is capable of determining coke moisture to better than 0.2 wt% over a wide range of coke thicknesses. The favoured technique uses a thick Li glass detector surrounded by a neutron moderator to determine simultaneously the fast neutron and γ-ray intensities. Recent laboratory measurements on single crushed coke samples showed that moisture can be determined to within about 0.23 wt% at coke thicknesses down to 50 mm. The technique can be applied to lump coke provided the neutron and γ-ray beams overlap closely. A long-term plant trial of the technique is planned to measure moisture in lump coke feed to the No.3 blast furnace at BHP, Newcastle, NSW.

40602 (INIS-mf–11495, pp. 178-180) **What causes whiskers growth?.** Sie, S.H. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Ryan, C.G.; Cousens, D.R.; Suter, G.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

In order to seek explanation for the origin and mechanism of dendritic growth (whiskers) on tin plated electronic circuitry components, a combination of ion beam analytical techniques has been used to study the surface region of selected samples. The study revealed the existence of diffused layer between the tin plating and the copper substrate, which suggests interdiffusion of Sn and Cu at the interface as the most likely driving mechanism for the growth, corroborating conclusions of some previous studies. Whisker growth is more likely to occur when the tin plating layer is less than 2 microns thick.

40603 (INIS-mf–11495, pp. 181-183) **Determination of PGE at crustal abundances.** Sie, S.H. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Ryan, C.G.; Suter, G.F.; Cousens, D.R.; Griffin, W.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A method combining fire-assay and PIXE has been developed to determine PGE and Au at crustal abundance levels. The simpler method employing lead and silver as collector yields Pt, Pd and Au concentrations at ppb level readily. NiS must be used as collector if the complete suite of PGE is required, but this method is not as convenient.

40604 (INIS-mf–11495, pp. 184-186) **Distribution of platinum group elements in accessory minerals of platinum bearing ores.** Cousens, D.R. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics); Griffin, W.L.; Ryan, C.G.; Sie, S.H.; Suter, G.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The concentrations of platinum group elements (PGEs) have been determined in accessory minerals and minor ore phases by PIXE microprobe at concentrations approaching the ultimate detection limits for the technique. Pyrrhotite, chromite, magnetite, olivine and ilmenite were found to have significant concentrations of the PGEs above the detection limits of 2-7ppm while pyroxene and orthopyroxene contained no PGEs above the detection limits. Trace level concentrations of Cu, Ni, Zn, Ga, Ge, Se, Rb, Sr, Y, Zr, Nb, Ba, Hg and Tl were measured in addition to the PGEs.

40605 (INIS-mf–11495, pp. 187-189) **Distribution of elements in stylar tissue of Nicotiana Alata (an ornamental tobacco), using a scanning proton microprobe.** Mazzolini, A.P. (Swinburne Inst. of Technology, Hawthorn (Australia). Dept. of Physics); Bonig, I.; Clarke, A.E.; Legge, G.J.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Using fixed and embedded tissue, we have used a scanning proton microprobe to investigate the distribution of elements from the style of an ornamental tobacco. The results indicate a high concentration of Si in the epidermis. All other elements detected were highly concentrated in the transmitting tissue.

40606 (INIS-mf–11499) **Aerosol measurements in a semi-arid zone (Beer-Sheva) using nuclear methods.** Haccoun, A.A. Ben-Gurion Univ. of the Negev, Beersheba (Israel). Sep 1980. 173p. (In Hebrew). Order Number DE89632496/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The aims of the research were: (1) to qualitatively and quantitatively determine the elemental composition of the aerosols in Beer-Sheva area and to measure the TSP in it, (2) to determine the aerosol size distribution, (3) to find the relation between the elemental composition of the aerosols and their diameter, (4) to determine correlations between the natural aerosols and the specific meteorological conditions of the Beer-Sheva area, (5) to determine the industrial pollution of the area. Between June 1977 and May 1978, 41 aerosol samples were measured for determination of their TSP mass concentration. The main methods used to analyse the aerosols were the Instrumental Neutron Activation Analysis and the X-Ray Fluorescence. The aerosols were examined and analysed during normal meteorological conditions, during and/or after rainfall, during and/or after Hamsin and after sandstorm conditions. Comparison of the TSP of Beer-Sheva area to to the mean TSP of world large cities shows that the normal TSP in Beer-Seva area is relatively high. Since Beer-Sheva is a small town (1977 population 110000), it can be concluded that the relatively high TSP is primarily due to the natural conditions prevailing in the Negev desert. 66 refs.

40607 (INIS-SU–89, pp. 162-163) **Application of flame-photometric method to define lithium niobate stoichiometric composition.** Zolotovitskaya, Eh.S.; Potapova, V.G.; Druzenko, T.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

LITHIUM COMPOUNDS/quantitative chemical analysis; NIOBATES/quantitative chemical analysis; ACCURACY; CHEMICAL COMPOSITION; MONOCRYSTALS; NIOBATES; PHOTOMETRY

40608 (IPNO-DRE–88-38) **Development of a device for rapid acquisition of spectra and application to experiments in spectro-electrochemistry.** Haltier, E.; Fourest, B.; David, F. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 22p. (In French). Order Number DE89903309/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

An ultrafast spectrophotometer (spectrum acquisition time of 512 microsec) is presented. This speed of acquisition allows applications to photochemical kinetics, pulsed radiolysis, and liquid phase chromatography to be envisaged. The computer system associated with the device is described. Tests with uranium show the satisfactory functioning of the apparatus.

40609 (IYF-R–3-268) **Blood element composition of Uzbekistan inhabitants.** Zhuk, L.I.; Kist, A.A.; Mikhol'skaya, I.N.; Osinskaya, N.S.; Tillaev, T.; Tursunbaev, S.I. AN Uzbekskoj SSR, Tashkent (USSR). Inst. Yadernoj Fiziki. 1987. 12p. (In Russian). Order Number DE89632506/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The method of instrumental neutron activation determination of 17 elements in Uzbekistan donor's blood was developed. 2790 samples have been analysed and received results were processed using M-6000 computer. The average contents were calculated and hystograms of element distribution in data set were made. The dependence of element content on different parameters (sex, age, place of residence, nationality, profession, hemoglobin content, Rh-factor, blood group, the time of sample obtaining) was shown which is to be ultimatly accounted when the environmental impacts on public heath and various human deseases are studied. 3 refs.; 7 figs.; 2 tabs.

40610 (IYF-R-3-291) **Biogeochemistry of antimony in separate Uzbekistan regions.** Nazarov, Sh.; Mansurov, K.; Khatamov, Sh.; Davirov, A.; Suvanov, M. AN Uzbekskoj SSR, Tashkent (USSR). Inst. Yadernoj Fiziki. 1987. 14p. (In Russian). Order Number DE89632507/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Antimony content in various subjects of environment, and it's behaviour in the system soil-water-plants-mammals' organs is determined by instrumental neutron activation method. On the basis of statistical data ensured, the sharp increasing of antimony content in plants and in wool of mammals in the regions of ore location is demonstrated. Plants concentrating antimony are determined. 9 refs.; 7 tabs.

40611 (PtUB–21, pp. 363-370) **Determination of isotopic composition of plutonium samples by means of laser-resonant ionization mass spectrometry.** Sattelberger, P. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie); Mang, M.; Muehleck, C.; Rimke, H.; Herrmann, G.; Trautmann, N.; Rehklau, D.; Ruster, W.; Otten, E.W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5735. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

Within the framework of the research project on 'Laser spectroscopy as a technique of analysis for waste disposal', the question is treated as to how far laser-resonant ionization mass spectrometry is applicable for such purposes, and what improvements can be achieved with respect to current methods. To attain a high element and isotope specificity, the ions are stimulated in three stages by means of the simultaneous radiation of three different laser frequencies. The isotope composition can be deduced from the time-of-flight measurements, for which pulsated lasers are particularly suitable, owing to the clear definition of the starting momentum. Saturation intensities and cross-sections with regard to apparatuses for the laser-resonant ionization of Pu-239, isotope shifts and isotope ratios for plutonium in synthetic mixtures were measured. (orig./RB).

40612 (PtUB–21, pp. 371-381) **Investigation of the applicability of X-ray fluorescence analysis with the totally reflecting sample carrier (TRFA) for purposes of waste analysis in reprocessing systems.** Eggers, I. (Hamburg Univ. (Germany, F.R.). Inst. fuer Anorganische und Angewandte Chemie); Haarich, M.; Knoechel, A.; Salow, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5665. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

For a more detailed characterization of the analytic method, MAW and HAW simulate solutions were investigated with specific excitation by molybdenum and tungsten. Theoretical detection limits and recovery rates in multielement standard solutions were determined; in this process a linear course of the calibration constants in the concentration range of 50 μg/l to 50 mg/l was discovered. The influence of uranium and thorium on the fission product concentrations and vice versa in the process simulate on the product range was investigated in different concentration ranges. (RB).

40613 (PtUB–21, pp. 403-407) **Determination of highly volatile fission products in environmental specimens.** Menzel, E. (Bonn Univ. (Germany, F.R.). Abt. Nuklearchemie); Clooth, G.; Aumann, D.C. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5474. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The aim of the research project is to work out radioanalytical detection methods for the fission products Se-79, Sb-125, Te-125 m and Te-127 m, methods with which the slightest traces of these fission products can be detected in soil and vegetation samples. To this end, a separation process was designed which is based essentially on distillation and clear-cut precipitation procedures. (orig./RB).

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Refer also to citation(s) 40042, 40119, 40557, 41363

40614 (CONF-880520–, pp. 207-210) **Correlation and estimation of aqueous solubilities of substituted benzenes, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons.** Tsai, C. (Kent State Univ., OH (USA)); Acree, W.E. Jr.; Blair, T.; Gifford, E.; Peterson, L.J.; Liao, S.T. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Quantitative structure-activity relationships have been studied for the aqueous solubility of halogenated benzenes (HBs), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) at 25°C. Multiple regression correlations of aqueous mole fraction solubility (X) with molecular descriptors (molecular connectivity indexes), melting point temperature (MP), and a combined molecular symmetry and structure descriptor (molecular redundancy index x molecular descriptor) have been developed. These correlations enable the aqueous solubility to be estimated from molecular structure and melting point temperature or solely from molecular connectivity indexes and a molecular redundancy index. Several newly defined molecular connectivity indexes have been utilized as molecular descriptors in this QSAR study.

40615 (CRN-CPR–88-11) **Quantitative analysis of impurities present in the trace state in CdTe.** Al-Neami, A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 85p. (In French). Order Number DE89903312/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Impurities in CdTe have been analyzed by PIXE using 3 MeV protons and by 1 MeV Ar ion induced X-ray emission. In the case of PIXE elements with $Z > 25$ are detected whereas with Ar ions only elements with $13 < Z < 18$ are analyzed. The latter elements cannot be analyzed by PIXE as a consequence of the overlopping of escape peaks form the strong L lines of Cd and Te. With Ar ions sensitivities of 40 to 300 ppm, depending on the element and the matrix (CdTe or Te) are obtained. The effects of different treatments of CdTe during the manufacture are examined.

40616 (DOE/ER/13488–3) **Thermodynamics of finite-time processes: Final report, 1986–89.** Chicago Univ., IL (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract

FG02-86ER13488. Order Number DE89015036/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The original goals of the project and their modifications are summarized. The various principal achievements are described, all related by the common thread of interpreting dissipation associated with finite-time constraints and with optimization under those constraints. The achievements are: resolution of a concern regarding the use of metric geometry and length for thermodynamic analyses; the completion of the analysis of a prototype "dissipative engine" or engine operating strictly by a dissipative process; the analysis of entropy production in the stopping of atomic beams; the determination of optimal behavior and optimal paths for time-constrained adiabatic engines; the development of a Hamiltonian approach to nonequilibrium systems with heat flow; and the combination of this Hamiltonian approach and the geometric analysis newly enabled by the first success of this list to provide a method for determining dissipation and optimal paths for nonequilibrium systems with heat and mass flow. 16 refs.

40617 (DOE/ER/60514–3) **Direct infrared absorption of clusters in pulsed molecular beams: Third progress report, August 1, 1988–June 30, 1989.** Muenter, J.S. Rochester Univ., NY (USA). Dept. of Chemistry. 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER60514. Order Number DE89015804/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report describes accomplishments over the past year in research supported by this grant. In addition, a proposal for continued work in this area over the next three years is presented. The general goal of the proposed work is to consolidate the experimental results obtained over the past several years and to focus these results on the creation of intermolecular potential functions. The ability to construct analytic intermolecular potential functions that accurately predict the energy of interaction between small molecules will have great impact in many areas of chemistry, biochemistry, and biology. A research project which includes this theoretical development, combined with our continuing experimental program, will be described. 2 figs.

40618 (FRCEA-TH–202) **Study of the physicochemical properties of the interface between titanium dioxide and various aqueous solutions.** Mazilier, C. Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-6 Univ., 75 (France). 1988. 239p. (In French). Order Number DE89903270/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

The aim of this work is the study of ion exchange capacity of titanium dioxide in view of high temperature water purification and radioactive effluent processing because of its resistance to heat and radiations. Titanium dioxide is obtained by alkaline hydrolysis of an aqueous solution of Ti (IV) and is characterized by analytical physical chemistry methods. Interface between TiO_2 and simple aqueous solutions (electrolytes) is more particularly studied by potentiometry.

40619 (INIS-SU–89, pp. 8-9) **Study of thermal stability of rare earth phosphates of $CsLnP_4O_{12}$ and $CsLnP_6O_{18}$ (Ln=La-Gd) composition.** Sazhenkov, A.Yu.; Chajkin, V.P.; Masloboev, V.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM PHOSPHATES/thermal degradation; RARE EARTH COMPOUNDS/thermal degradation; ATOMIC NUMBER; CHEMICAL COMPOSITION; HIGH TEMPERATURE; MELTING POINTS; MOLECULAR STRUCTURE; SENSITIVITY

40620 (INIS-SU–89, pp. 23) **Physicochemical properties of double molybdates, tungstates of cesium (rubidium) and bivalent elements.** Mokhosoev, M.V. (AN SSSR, Ulan-Ude (USSR). Inst. Estestvennykh Nauk); Tsyrenova, G.D.; Bazarova, Zh.G.; Khazheeva, Z.I. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

BARIUM TUNGSTATES/crystal structure; BARIUM TUNGSTATES/phase diagrams; CADMIUM TUNGSTATES/crystal structure; CADMIUM TUNGSTATES/phase diagrams; CESIUM TUNGSTATES/crystal structure; CESIUM TUNGSTATES/phase diagrams; MOLYBDATES/crystal structure; MOLYBDATES/phase diagrams; RUBIDIUM TUNGSTATES/crystal structure; RUBIDIUM TUNGSTATES/phase diagrams; CHEMICAL COMPOSITION; CHEMICAL REACTIONS; CRYSTALLIZATION; MELTING POINTS; MOLYBDATES; TRANSITION ELEMENT COMPOUNDS

40621 (INIS-SU–89, pp. 27-28) **Preparation and properties of double compounds of the composition $LIREO_4$, where E-Ge, V, Nb; $R-M^2$, M^3.** Barinova, O.P. (Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR)); Balakireva, T.P.; Provotorov, M.V.; Majer, A.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

INDIUM COMPOUNDS/chemical preparation; INDIUM COMPOUNDS/electric conductivity; LANTHANUM COMPOUNDS/chemical preparation; LANTHANUM COMPOUNDS/electric conductivity; NIOBATES/chemical preparation; NIOBATES/electric conductivity; VANADATES/chemical preparation; VANADATES/electric conductivity; ALKALINE EARTH METAL COMPOUNDS; CERAMICS; CHEMICAL COMPOSITION; GERMANATES; LITHIUM COMPOUNDS; MELTING POINTS; MONOCRYSTALS; NIOBATES; REFRACTIVITY; VANADATES

40622 (INIS-SU–89, pp. 29-30) **Ternary systems including lithium and niobium (tantalum) oxides.** Shukaev, I.L. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR)); Nalbandyan, V.B.; Medvedeva, L.I.; Khodzhaeva, Eh.O. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CADMIUM OXIDES/chemical preparation; CADMIUM OXIDES/phase diagrams; TRANSITION ELEMENT COMPOUNDS/chemical preparation; TRANSITION ELEMENT COMPOUNDS/phase diagrams; ALUMINIUM OXIDES; CHEMICAL COMPOSITION; CRYSTAL STRUCTURE; IONIC CONDUCTIVITY; LITHIUM OXIDES; MAGNESIUM OXIDES; SOLID SOLUTIONS; ZINC OXIDES

40623 (INIS-SU–89, pp. 51) **Ternary chloride-nitrate mutual salt systems of alkali and alkaline earth metals.** Il'yasov, I.I. (Zaochnyj Inst. Sovetskoj Torgovli, Rostov-na-Donu (USSR)); Volchanskaya, V.V.; Lepeshkov, I.N.; Davranov, M.; Iskandarov, K. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/chemical reactions; ALKALI METAL COMPOUNDS/phase diagrams; ALKALINE EARTH METAL COMPOUNDS/chemical reactions; ALKALINE EARTH METAL COMPOUNDS/phase diagrams; CHLORIDES; CRYSTALLIZATION; ELECTROLYTES; EUTECTICS; NITRATES; SOLID SOLUTIONS

40624 (INIS-SU–89, pp. 64-65) **Role of outer spheric interactions in double salt crystallization processes from ternary water-salt systems, containing salts of rare alkali and transition metals.** Borina, A.F. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii). AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM CHLORIDES/chemical reactions; AQUEOUS SOLUTIONS; COBALT COMPLEXES; CRYSTALLIZATION; FORMATES; HYDRATION; NICKEL COMPLEXES; QUANTITY RATIO

40625 (INIS-SU–89, pp. 66-67) **Thermodynamic study of the systems with rare alkali element salts.** Lupejko, T.G. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR)); Tarasov, N.I. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/free enthalpy; CESIUM COMPOUNDS/phase diagrams; CRYSTALLIZATION; HALIDES; HIGH TEMPERATURE; MATHEMATICAL MODELS; SODIUM COMPOUNDS; VERY HIGH TEMPERATURE

40626 (INIS-SU–89, pp. 67-68) **Four-component mutual systems based on tartaric acid, rare alkali metal sulfates.** Akopov, E.K. (Krasnodarskij Politekhnicheskij Inst., Krasnodar (USSR)); Rudakova, S.G.; Vasil'eva, N.B. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM CHLORIDES/chemical reactions; CESIUM CHLORIDES/phase diagrams; CESIUM SULFATES/chemical reactions; CESIUM SULFATES/phase diagrams; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; CHEMICAL REACTION KINETICS; DEHYDRATION; HYDRATES; PYROLYSIS; RUBIDIUM COMPOUNDS; TARTRATES

40627 (INIS-SU–89, pp. 69-70) **Complexing in solutions of halides and nitrates of rubidium and cesium.** Allakhverdov, G.R. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Khimicheskikh Reaktivov i Osobo Chistykh Veshchestv, Moscow (USSR)); Piskareva, T.Yu.; Bessarabov, A.M. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPLEXES/chemical preparation; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; ELECTROLYTES; HALIDES; NITRATES; QUANTITY RATIO; STABILITY; THERMODYNAMIC ACTIVITY

40628 (INIS-SU–89, pp. 70) **Perchlorate compounds of lithium, rubidium and cesium.** Babaeva, V.P. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Skogareva, L.S.; Ivanova, T.A.; Roslovskij, V.Yu. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/chemical preparation; ALKALI METAL COMPOUNDS/pyrolysis; CERIUM COMPLEXES/chemical preparation; CERIUM COMPLEXES/pyrolysis; TRANSITION ELEMENT COMPLEXES/chemical preparation; TRANSITION ELEMENT COMPLEXES/pyrolysis; PYROLYSIS; BISMUTH COMPLEXES; CHEMICAL COMPOSITION; CRYSTAL LATTICES; PERCHLORATES; VALENCE

40629 (INIS-SU–89, pp. 71) **Investigation of lithium iodate interaction with other lithium salts in aqueous solutions at 25 grad. C.** Arkhipov, S.M.; Shklovskaya, R.M.; Kashina, N.I.; Kidyarov, B.I.; Kuzina, V.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

BORATES/chemical reactions; BORATES/phase diagrams; HALIDES/chemical reactions; HALIDES/phase diagrams; IODATES/chemical reactions; IODATES/phase diagrams; PERRHENATES/chemical reactions; PERRHENATES/phase diagrams; AQUEOUS SOLUTIONS; BORATES; CHEMICAL COMPOSITION; HALIDES; HYDRATES; IODATES; LITHIUM COMPOUNDS; MEDIUM TEMPERATURE; PERRHENATES; SALTING-OUT AGENTS; SOLUBILITY

40630 (INIS-SU–89, pp. 71-72) **Interaction of lithium iodate with iodates of elements of 3B and 4A groups of the Periodic system.** Shklovskaya, R.M.; Arkhipov, S.M.; Kidyarov, B.I.; Kuzina, V.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

INDIUM COMPOUNDS/chemical reactions; INDIUM COMPOUNDS/solubility; IODATES/chemical reactions; IODATES/solubility; TRANSITION ELEMENT COMPOUNDS/chemical reactions; TRANSITION ELEMENT COMPOUNDS/solubility; ALUMINIUM COMPOUNDS; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; CHEMICAL PREPARATION; GALLIUM COMPOUNDS; HYDRATES; SOLUBILITY; IODATES; LITHIUM COMPOUNDS; MEDIUM TEMPERATURE; PHASE DIAGRAMS; SOLID SOLUTIONS

40631 (INIS-SU–89, pp. 74-75) **Calculation of activity coefficients of cesium chloride in the system NaCl-CsCl-H_2O.** Denisov, D.A. (Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR)); Frolov, Yu.G. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM CHLORIDES/phase diagrams; CESIUM CHLORIDES/thermodynamic activity; ACCURACY; AQUEOUS SOLUTIONS; DIFFERENTIAL EQUATIONS; SODIUM CHLORIDES

40632 (INIS-SU–89, pp. 78) **Forecasting of topological types of phase diagrams for binary systems with participation of rare alkali element halides and oxides.** Safonov, V.V. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii, Moscow (USSR)); Mireev, V.A.; Odintsov, K.Yu.; Podorozhnyj, A.M. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/phase diagrams; HALIDES/phase diagrams; PHASE DIAGRAMS/forecasting; BINARY MIXTURES; COMPUTER CALCULATIONS; FORTRAN; HALIDES; MELTING POINTS; OXIDES; FORECASTING

40633 (INIS-SU–89, pp. 79-80) **Study of interaction in ternary systems with participation of bromides and iodides of rubidium and cesium.** Volchanskaya, V.V. (Zaochnyj Inst. Sovetskoj Torgovli, Rostov-na-Donu (USSR)); Dunaeva, T.I.; Il'yasov, I.I. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/chemical reactions; ALKALI METAL COMPOUNDS/phase diagrams; HALIDES/chemical reactions; HALIDES/phase diagrams; CHEMICAL COMPOSITION; CRYSTALLIZATION; EUTECTICS; HALIDES; HIGH TEMPERATURE; MELTING POINTS; REACTION HEAT; SOLID ELECTROLYTES; SOLID SOLUTIONS

40634 (INIS-SU–89, pp. 80-81) **Physicochemical properties and adsorption complexes on the surface of rare alkali element halides.** Gluz, E.B. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR)); Shcherbakov, I.N.; Sobolev, V.A.; Kogan, V.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPLEXES/electronic structure; CESIUM COMPOUNDS/adsorbents; ADSORPTION HEAT; ADSORBENTS;

CHEMISORPTION; ELECTRON DENSITY; HALIDES; HYDROGEN; OXYGEN; WATER

40635 (INIS-SU–89, pp. 81) **Interaction of sulfuric acid with sulfate salts of rare alkali elements of D.I. Mendeleev's Periodic System.** Storozhenko, V.A. (Poltavskij Meditsinskij Stomatologicheskij Inst., Poltava (Ukrainian SSR)); Konik, L.P.; Nalivajko, E.M. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/chemical reactions; ALKALI METAL COMPOUNDS/phase diagrams; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; CRYSTALLIZATION; MEDIUM TEMPERATURE; PHASE STUDIES; SULFATES; SULFURIC ACID

40636 (INIS-SU–89, pp. 82-83) **Four-component mutual systems based on nitrates and sulfates of rare alkali metals in nonaqueous medium.** Akopov, E.K. (Krasnodarskij Politekhnicheskij Inst., Krasnodar (USSR)); Kraev, S.M. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/phase diagrams; CRYSTALLIZATION; HIGH TEMPERATURE; MOLTEN SALTS; NITRATES; PHASE STUDIES; SOLID SOLUTIONS; SULFATES

40637 (INIS-SU–89, pp. 84) **Behaviour of alkali metal ions in sulfate solutions.** Fedorov, V.A. (Sibirskij Tekhnologicheskij Inst., Krasnoyarsk (USSR)); Dezhina, G.S. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/phase diagrams; ALKALI METAL COMPOUNDS/solubility; STRONTIUM SULFATES/phase diagrams; STRONTIUM SULFATES/solubility; SOLUBILITY; AQUEOUS SOLUTIONS; CHEMICAL REACTIONS; CHLORIDES; ELECTROLYTES; PERCHLORATES

40638 (INIS-SU–89, pp. 84-85) **Thermodynamics of phase equilibria in the system Li, K, Cs parallel or parallel to or concatenated SO_4-H_2O at 25 grad. C.** Kalinkin, A.M. (0339100SU); Vasin, S.K.; Filippov, V.K. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM SULFATES/phase diagrams; CESIUM SULFATES/solubility; AQUEOUS SOLUTIONS; SOLUBILITY; CHEMICAL REACTIONS; CRYSTALLIZATION; EQUILIBRIUM; LITHIUM SULFATES; MEDIUM TEMPERATURE; PHASE STUDIES; POTASSIUM SULFATES

40639 (INIS-SU–89, pp. 86-88) **Study of thermodynamic properties of Li_2O in five quasi-binary cross-sections of the systems.** Kozhina, E.L. (0343600SU); Shakhmatkin, B.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

BORON OXIDES/chemical reactions; BORON OXIDES/phase diagrams; ELECTROMOTIVE FORCE; GLASS; LITHIUM OXIDES; QUANTITY RATIO; SILICON OXIDES; TEMPERATURE DEPENDENCE; VERY HIGH TEMPERATURE

40640 (INIS-SU–89, pp. 89-90) **Features of crystal chemistry of mixed oxides containing super-large cations.** Nalbandyan, V.B. (Ryazanskij Gosudarstvennyj Univ., Ryazan (USSR)). AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/coordination number; ALKALI METAL COMPOUNDS/crystal structure; TELLURIUM OXIDES/coordination number; TELLURIUM OXIDES/crystal structure; TRANSITION ELEMENT COMPOUNDS/coordination number; TRANSITION ELEMENT COMPOUNDS/crystal structure; ATOMIC RADII; CATIONS

40641 (INIS-SU–89, pp. 90-91) **Transition to electrolyte-aqueous solvent in solutions of Li and Cs formates and their electric conductivity.** Lyashchenko, A.K. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Lileev, A.S.; Ivanova, K. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/electric conductivity; CESIUM COMPOUNDS/solubility; AQUEOUS SOLUTIONS; SOLUBILITY; ELECTROLYTES; FORMATES; HYDRATION; MEDIUM TEMPERATURE; PHASE DIAGRAMS; QUANTITY RATIO

40642 (INIS-SU–89, pp. 91-92) **Interaction of alkali metal cations with ferrocenoyl-β-diketone in aqueous solutions.** Matveev, V.D. (Sibirskij Tekhnologicheskij Inst., Krasnoyarsk (USSR)); Khudonogov, A.V.; Guseva, L.D.; Statsenko, I.V.; Isaev, I.D.; Tverdokhlebov, V.P. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPLEXES/chemical preparation; CESIUM COMPLEXES/stability; AQUEOUS SOLUTIONS; STABILITY; DIENES; IRON COMPLEXES; KETONES; MEDIUM TEMPERATURE; MOLECULAR STRUCTURE; PH VALUE; SOLUBILITY

40643 (INIS-SU–89, pp. 92) **Temperature dependence of solubility of rubidium and cesium sulfates in dimethyl sulfoxide.** Tsivileva, O.V. (Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR)); Mustafin, D.I.; Vorob'ev, A.F. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM SULFATES/solubility; SOLUBILITY; DMSO; EQUILIBRIUM; MEDIUM TEMPERATURE; TEMPERATURE DEPENDENCE

40644 (INIS-SU–89, pp. 93) **Features of solvation of lithium, rubidium and cesium ions in solvents with spatial net of H-bonds.** Rodnikova, M.N. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Nosova, T.A.; Gulevich, A.B. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/solvation; AMINES; AQUEOUS SOLUTIONS; SOLVATION; CHEMICAL BONDS; ELECTRIC CONDUCTIVITY; GLYCOLS; MEDIUM TEMPERATURE; MOLECULAR STRUCTURE; NONAQUEOUS SOLVENTS; SELF-DIFFUSION; TEMPERATURE DEPENDENCE

40645 (INIS-SU–89, pp. 99) **Study of lithium, rubidium, and cesium sorption mechanism from aqueous solutions disubstituted titanium (4), zirconium (4) and hafnium (4) phosphates.** Chernorukov, N.G. (Gor'kovskij Gosudarstvennyj Univ., Gorki (USSR)); Zhuk, M.I.; Velikzhanina, E.I. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/ion exchange; ALKALI METAL COMPOUNDS/separation processes; HAFNIUM PHOSPHATES/inorganic ion exchangers; ZIRCONIUM PHOSPHATES/inorganic ion exchangers; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; CHEMICAL REACTION KINETICS; DISTRIBUTION FUNCTIONS; HYDRATES; MEDIUM TEMPERATURE; PYROLYSIS PRODUCTS; TITANIUM PHOSPHATES

40646 (INIS-SU–89, pp. 164-165) **Heterophase synthesis of lithium metaniobate.** Molchanova, V.S. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii, Moscow (USSR)); Korovin, S.S.; Donskaya, T.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

LITHIUM COMPOUNDS/chemical preparation; NIOBATES/chemical preparation; ACTIVATION ENERGY; CHEMICAL REACTION KINETICS; IMPURITIES; NIOBATES; POWDERS

40647 (INIS-SU–89, pp. 100) **Investigation into sorption of rubidium and cesium salts crown-containing cellulose.** Abakumova, N.I.; Remez, V.P.; Shubin, A.S. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/chemisorption; ADSORBENTS; AQUEOUS SOLUTIONS; CELLULOSE; CHEMISORPTION; HETEROCYCLIC COMPOUNDS; PH VALUE; POLYETHYLENE GLYCOLS

40648 (INIS-SU–89, pp. 101) **Adsorbents based on oceanic iron manganese concretion for selective sorption of rare alkali elements.** Chelishchev, N.F. (Ministerstvo Geologii SSSR, Moscow (USSR)); Gribanova, N.F. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/adsorption; CESIUM COMPOUNDS/separation processes; ADSORBENTS; AQUEOUS SOLUTIONS; ADSORPTION; DISTRIBUTION FUNCTIONS; MINERALS

40649 (INIS-SU–89, pp. 103) **Sorption technology of natural brines processing for lithium, rubidium, and cesium compounds.** Vol'khin, V.V. (Permskij Politekhnicheskij Inst., Perm (USSR)); Zil'berman, M.V.; Chirkova, L.G.; Kozlova, G.A.; Chentsov, T.V.; Elizatova, I.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/ion exchange; CESIUM COMPOUNDS/purification; INORGANIC ION EXCHANGERS/chemical preparation; BRINES; PURIFICATION; EQUILIBRIUM; FLOWSHEETS

40650 (INIS-SU–89, pp. 103-104) **Development of technology and pilot-plant production of inorganic electron-ion exchangers of FS type, selective to rubidium and cesium.** Zil'berman, M.V. (Permskij Politekhnicheskij Inst., Perm (USSR)); Kalyuzhnyj, A.V.; Alikin, V.V.; Kalinin, N.F.; Kozlova, G.A.; Sesyunina, E.A.; Chebykina, N.M.; Vol'khin, V.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/ion exchange; CESIUM COMPOUNDS/separation processes; INORGANIC ION EXCHANGERS/ion exchange; INORGANIC ION EXCHANGERS/production; FERROCYANIDES; FLOWSHEETS; PRODUCTION; TRANSITION ELEMENT COMPOUNDS

40651 (INIS-SU–89, pp. 104) **Kinetics of cesium sorption by composite adsorbent, including copper ferrocyanide and silica gel.** Pan, L.S. (Permskij Politekhnicheskij Inst., Perm (USSR)); Vol'khin, V.V.; Zil'berman, M.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/chemical reaction kinetics; CESIUM COMPOUNDS/ion exchange; AQUEOUS SOLUTIONS; COMPOSITE MATERIALS; COPPER COMPOUNDS; FERROCYANIDES; INORGANIC ION EXCHANGERS; POTASSIUM COMPOUNDS; SEPARATION PROCESSES; SILICA GEL

40652 (INIS-SU–89, pp. 105-106) **Sorption concentrating and separation of rubidium and cesium by tin phosphate.** Smirnov, G.I. (Ivanovskij Gosudarstvennyj Univ., Ivanovo (USSR)); Chernyak, A.S.; Kostromina, O.N.; Zorina, I.Yu.; Shpejzer, B.G. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/ion exchange; CESIUM COMPOUNDS/multi-element separation; AMORPHOUS STATE; AQUEOUS SOLUTIONS; DISTRIBUTION FUNCTIONS; FREE ENTHALPY; INORGANIC ION EXCHANGERS; RUBIDIUM COMPOUNDS; TIN PHOSPHATES

40653 (INIS-SU–89, pp. 106) **Thermochemistry of cesium sorption by modified alumo gel.** Zueva, V.V. (Voronezhskij Tekhnologicheskij Inst., Voronezh (USSR)); Arkhangel'skaya, N.V.; Amelin, A.N.; Antipov, M.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/chemisorption; CESIUM COMPOUNDS/reaction heat; ALUMINIUM OXIDES; AQUEOUS SOLUTIONS; CHEMISORPTION; COPPER COMPOUNDS; FERROCYANIDES; MEDIUM TEMPERATURE; QUANTITY RATIO

40654 (INIS-SU–89, pp. 107-108) **Study of ion exchange equilibrium of cesium dissolution reaction from pollucite in hydrochloric acid solution.** Kogan, V.S. (Kazakhskij Nauchno-Issledovatel'skij Inst. Mineral'nogo Syr'ya, Alma-Ata (USSR)); Favorskaya, L.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/dissolution; CESIUM COMPOUNDS/ion exchange; AQUEOUS SOLUTIONS; CALCIUM CHLORIDES; DISSOLUTION; EQUILIBRIUM; FREE ENTHALPY; HYDROCHLORIC ACID; MINERALS; QUANTITY RATIO

40655 (INIS-SU–89, pp. 108) **Kinetics of cesium dissolution from pollucite in hydrochloric acid medium.** Kogan, V.S.; Favorskaya, L.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPOUNDS/chemical reaction kinetics; CESIUM COMPOUNDS/dissolution; ALKALINE EARTH METAL COMPOUNDS; ALUMINIUM CHLORIDES; AQUEOUS SOLUTIONS; DISSOLUTION; ELECTROLYTES; HYDROCHLORIC ACID; MINERALS; QUANTITY RATIO

40656 (INIS-SU–89, pp. 108-109) **Kinetics of sulfuric acid leaching of mica products depending on element composition.** Kuznetsova, E.G.; Petrov, N.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya.

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ALKALI METAL COMPOUNDS/chemical reaction kinetics; ALKALI METAL COMPOUNDS/leaching; ACTIVATION ENERGY; LEACHING; CHEMICAL COMPOSITION; CRYSTAL STRUCTURE; MICA; SULFURIC ACID

40657 (INIS-SU–89, pp. 110-111) **Effect of structure of substituted phenol on rubidium and cesium extraction from strong-alkaline media.** Apanasenko, V.V. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii, Moscow (USSR)); Reznik, A.M.; Gol'shtejn, O.P. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM COMPLEXES/solvent extraction; AQUEOUS SOLUTIONS; CHEMICAL REACTION KINETICS; MOLECULAR STRUCTURE; PH VALUE; PHENOLS

40658 (INIS-SU–89, pp. 168) **Preparation and some properties of $Cs_3(Rb_3)Sb_2(BI_2)I_9$.** Kun, S.V. (Uzhgorodskij Gosudarstvennyj Univ., Uzhgorod (Ukrainian SSR)); Peresh, E.Yu.; Lazarev, V.B.; Orinchaj, A.V.; Zhukova, T.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ANTIMONY IODIDES/crystal growth; ANTIMONY IODIDES/phase diagrams; BISMUTH IODIDES/crystal growth; BISMUTH IODIDES/phase diagrams; CESIUM IODIDES/crystal growth; CESIUM IODIDES/phase diagrams; RUBIDIUM IODIDES/crystal growth; RUBIDIUM IODIDES/phase diagrams; CHEMICAL COMPOSITION; CHEMICAL PREPARATION; CRYSTALLIZATION; MONOCRYSTALS; PHYSICAL PROPERTIES

40659 (INIS-SU–89, pp. 174-175) **Use of rare alkali metal halides in high-temperature processes.** Glagolevskaya, A.L. (AN SSSR, Apatity (USSR). Kol'skij Filial); Kuznetsov, S.A.; Kuznetsova, S.V.; Polyakov, E.G.; Stangrit, P.T. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

ALKALI METAL COMPOUNDS/electrolytes; HAFNIUM COMPLEXES/electrolysis; HAFNIUM COMPLEXES/reduction; ELECTROLYTES; CHEMICAL REACTION KINETICS; DIFFUSION; EUTECTICS; ELECTROLYSIS; REDUCTION; HALIDES; MOLTEN SALTS; USES; VERY HIGH TEMPERATURE

40660 (INIS-SU–89, pp. 184) **Solubility of lithium fluoroborate in propylenecarbonate, 1,2-dimethoxyethane and their mixtures.** Sinegubova, S.I. (Saratovskij Gosudarstvennyj Univ., Saratov (USSR)); Demakhin, A.G. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

BORON FLUORIDES/phase diagrams; BORON FLUORIDES/solubility; LITHIUM FLUORIDES/phase diagrams; LITHIUM FLUORIDES/solubility; SOLUBILITY; CHEMICAL COMPOSITION; CRYSTALLIZATION; MEDIUM TEMPERATURE; MELTING POINTS; MIXED SOLVENTS; ORGANIC SOLVENTS; SOLVATION

40661 (INIS-SU–89, pp. 193-194) **Synthesis of heavy alkali metal ferrites and analysis of their properties.** Sudzilovskaya, T.N. (Yaroslavskij Politekhnicheskij Inst., Yaroslavl (USSR)); Stepanov, E.G.; Rzhevskaya, N.N.; Yun, V.V.; Kotel'nikov, G.R. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

CESIUM OXIDES/chemical preparation; CESIUM OXIDES/phase studies; IRON OXIDES/chemical preparation; IRON OXIDES/phase studies; ABSORPTION SPECTRA; CHEMICAL COMPOSITION; CRYSTAL LATTICES; HYDROLYSIS

40662 (LA-UR–89-374) **Chemistry of detonation soot: Diamonds, graphite, and volatiles.** Greiner, N.R.; Hermes, R. Los Alamos National Lab., NM (USA). [1989]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–16: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007749/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Detonation of a number of pure and composite explosives in tanks filled with Ar gas have yielded solid carbonaceous products (soots) with a rich chemistry. Although there are similarities, the soot from each explosive has some uniqueness. The soot are composed of very small solid particles of graphite and often diamond, having characteristic dimensions of about 20 atomic diameters. This small size and the presence of a 25 wt % heat-labile component implies an important surface chemistry for these soots. The heat-labile compounds may give clues about the structure, the surface chemistry, and the mechanism of soot formation. 17 refs., 3 figs., 1 tab.

40663 (LA-UR–89-2259) **Development of NDA instruments for the Los Alamos SIS [Special Isotope Separation] Facility.** Li, T.K.; Rinard, P.M.; Schneider, C.M.; Atencio, J.D.; Hyman, D.H.; Kroncke, K.E.; Painter, J.; Siebelist, R.; Holbrooks, O.; Halbig, J.K. Los Alamos National Lab., NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–57: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015272/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Los Alamos Special Isotope Separation Facility produces special plutonium isotopes and converts plutonium scrap by using the molecular laser isotope separation (MLIS) process in a gaseous plutonium hexafluoride (PuF_6) phase. To provide important process-development and accountability information, we have developed and installed four nondestructive assay (NDA) instruments for that facility. These instruments are (1) an in-line plutonium isotopic analysis system to measure plutonium isotopes in gaseous, solid, and liquid phases, (2) an in-line sodium iodide (NaI) monitoring system consisting of six 2-in. by 2-in., two 2-in. by 24-in., and one 2-in. by 22-in. NaI detectors at specified components (a feed bottle, a feed-transfer cold trap, a compressor, a heat exchanger, a collector, a nozzle prefilter, and a tails cold trap) in the flow loop, (3) a portable high-resolution germanium gamma-ray system for plutonium isotopic analysis, and (4) a portable NaI gamma-ray holdup monitor. This paper discusses the measurement principles, hardware and software designs, and performance associated with these NDA instruments. 2 refs, 11 figs., 2 tabs.

40664 (LBL–27265) **Heat capacity measurements of atoms and molecules adsorbed on evaporated metal films.** Kenny, T.W. Lawrence Berkeley Lab., CA (USA). May 1989. 110p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89015229/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Investigations of the properties of absorbed monolayers have received great experimental and theoretical attention recently, both because of the importance of surface processes in practical applications such as catalysis, and the importance of such systems to the understanding of the fundamentals of thermodynamics in two dimensions. We have adapted the composite bolometer technology to the construction of microcalorimeters. For these calorimeters, the adsorption substrate is an evaporated film deposited on one surface of an optically polished sapphire wafer. This approach has allowed us to make the first measurements of the heat capacity of submonolayer films of ^4He adsorbed on metallic films. In contrast to measurements of ^4He adsorbed on all other insulating substrates, we have shown that ^4He on silver films occupies a two-dimensional gas phase over a broad range of coverages and temperatures. Our apparatus has been used to study the heat capacity of Indium flakes. CO multilayers, ^4He adsorbed on sapphire and on Ag films

and H_2 adsorbed on Ag films. The results are compared with appropriate theories. 68 refs., 19 figs.

40665 (LYCEN-T–8824) **Nonbijective canonical transformations and applications to some dynamical systems.** Negadi, T. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France). 1988. 180p. (In French). Order Number DE89903231/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A first part is devoted to a presentation of a simplified formalism concerning non-bijective canonical transformations and to an interpretation of some of them in the framework on the theory of Lie algebras. In particular, the well-known Levi-Civita and Kustaanheimo-Stiefel transformations are generalized to the non-compact case and to the dimensions 2, 4 and 8. The differential and geometrical properties of the so-called Hurwitz transformations as well as their interpretation in terms of Lie algebras under constraints are given. A second part is concerned with the application of certain non-bijective canonical transformations (and in particular the Kustaanheimo-Stiefel transformation) to some dynamical systems of interest in theoretical and in chemical physics. The applications concern especially hydrogenoid systems, free or embedded in static and uniform electromagnetic fields, and systems presenting a line of singularity (as the Hartmann system, the Aharonov-Bohm system, and the dyonium system). The Kustaanheimo-Stiefel transformation allows to convert the Schroedinger equations for the later systems into Schroedinger equations for oscillators (harmonic, anharmonic, non-harmonic) in 2 or 4 dimensions.

40666 (PtUB–21, pp. 323-330) **Investigation of the separation of foreign substances in the pyrohydrolysis of B_4C in the presence of CeO_2.** Roth, C. (Muenchen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie); Amberger, E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5625. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The reaction temperature of the pyrohydrolysis of B_4C can be reduced from 1473 K to 1173 K by adding CeO_2. The boron is enriched to H_3BO_3 in the aqueous phase. CeO_2 remains a solid residue. To test the separation of metallic impurities during pyrohydrolysis, admixtures of V, Cr, Mn, Fe, Co, Ni and Mo are added to the B_4C-CeO_2 mixture in the form of their oxides. The concentration of foreign substances in the condensate is determined by means of atomic emission spectroscopy. V, Fe, Co and Ni cannot be detected. The Cr and Mn concentrations lie within the ppb range, though below the detection limit of the method applied. Mo is transported as $(MoO_2(OH)_2)_n$ via the gaseous phase, and 80% of it is detected in the aqueous phase. (orig.).

4004 Electrochemistry

Refer also to citation(s) 40504

40667 (SAND–89-1273C) **Thin foil electrochemical cells: High sensitivity fusion tests and in-situ ion beam measurements of deuterium loading.** Knapp, J.A.; Guilinger, T.R.; Kelly, M.J.; Doyle, B.L.; Walsh, D.; Tsao, S.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8905126–2: Workshop on cold fusion phenomena, Santa Fe, NM (USA), 23-25 May 1989). Order Number DE89015795/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Electrochemical cells constructed with a thin Pd or Ti foil electrode mounted at one wall of the cell have been used both to test for the existence of "cold fusion" and to directly measure D:Pd loading ratios in an operating cell. The first type of experiment used a surface-barrier particle detector positioned a few mm from the foil to provide a very sensitive monitor for possible fusion-generated protons at 3.02 MeV. The detection limit for this arrangement is estimated to be 10^{-24} fusions/deuterium/second, assuming a bulk fusion effect. These experiments included cells with 5 and 25 μm thick Pd foils, 10 μm Ti foils, parallel experiments with 0.1 M LiOD (heavy water) in one cell and LiOH (light water) in another, current densities up to 0.5 A/cm^2, and run times as long as 22 days. No evidence for fusion products was seen. The second type of experiment using these cells, both as an adjunct to the fusion tests and to provide new information, was the use of external beam nuclear reaction analysis to directly monitor the loading and unloading of deuterium in the foil of an operating cell. Using a 1.5 MeV ^{3}He ion beam in air, the deuterium in the outer 2 μm of the exposed Pd foil was measured for the first time using the D(^{3}He,p) nuclear reaction. The maximum D:Pd ratios observed using this technique were 0.8–0.9. 12 refs., 4 figs.

40668 **Electronic conduction in molten sodium chloride.** Haarberg, G.M. (Brookhaven National Lab., Dept. of Applied Science, Upton, L.I., NY (US)); Osen, K.S.; Egan, J.J. vp. of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, HI (USA), 18-23 Oct 1987).

The electronic conductivity of molten NaCl was determined as a function of the activity of Na at 850 and 900^{0}C by using a polarization technique. This technique was developed for detecting small electronic contribution to the total conductivity in solid electrolytes.

4005 Photochemistry

Refer also to citation(s) 41058, 41059, 41061, 41064, 41065, 41068, 41071, 41072, 41319

4006 Radiation Chemistry

Refer also to citation(s) 40694, 41063

40669 (INIS-mf–11494) **14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).** Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. 77p. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The conference was held in association with the Polymer Division of the Royal Australian Chemical Institute. The handbook includes abstracts of fifty three papers.

40670 (PtUB–21, pp. 57-80) **Gamma irradiation of oxyhydrogen gas mixtures below and above the explosion limit.** Dautzenberg, D. (Technische Univ. Muenchen, Garching (Germany, F.R.). Inst. fuer Radiochemie); Heusinger, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5321 A. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

The formation of hydrogen by radiolysis and its reactivity in gas mixtures under radiolytic conditions is of considerable significance for the safe design of transport and storage containers for radioactive waste. A report is presented on the radiolysis of stoichiometrical H_2:O_2 mixtures and of those with a surplus or admixtures of O_2, Ar, N_2 (dependence on γ dose, mixing proportion, temperature, pressure, pretreatment, reactor surface); the report also includes additives acting as inhibitors, activation processes, which lead to inflamation or a shift of explosion limit, as well as the model calculations done to this end. (RB).

40671 (PtUB–21, pp. 265-280) **Study of the modification of technological and chemical properties of polymers due to**

gamma irradiation. Menhofer, H. (Technische Univ. Muenchen, Garching (Germany, F.R.). Inst. fuer Radiochemie); Opp, D.; Zluticky, J.; Heusinger, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5554. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

These investigations (mainly into silicone polymers) show no striking dose rate effect in the range up to 1 J/g.h. The formation of gas (H_2, CH_4, CO, CO_2), the change in cross-linking and segment mobility and also technological properties were investigated. The chemical degradation due to radiation is mainly influenced by temperature and partial oxygen pressure. In the absence of O_2 the gases H_2, CH_4, C_2H_6 are formed, in the presence of O_2 the gases CO and CO_2 are formed in addition. Irradiation in vacuum leads to an increased cross-linking and thus to a faster material embrittlement, as compared with the presence of oxygen, but it also leads to a higher segment mobility. (RB).

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 39918

40672 (DOE/ER/60512–3) **Preparation of radiopharmaceuticals labeled with gallium and indium: Progress report, June 1, 1986–June 30, 1989.** Welch, M.J. Washington Univ., St. Louis, MO (USA). Edward Mallinckrodt Inst. of Radiology. Jun 1989. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER60512. Order Number DE89015805/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This project was designed to carry out routine production of Ga-68 labeled radiopharmaceuticals for use, particularly in pulmonary studies; to continue work on the development of Ga-68 labeled radiopharmaceuticals that could be used with positron emission tomography; to evaluate indium-111 and possibly gallium-68 labeled antibodies in animal models; to continue development of new chelates and bifunctional chelates for use as radiopharmaceuticals; and to develop new approaches to the delivery of radiopharmaceuticals to the brain. We have made major advances in all of these areas. In area one, we have shown that gallium-68 radiopharmaceuticals can be produced routinely under robotic control for patient studies. This has resulted in several publications by us and by our collaborators in the Pulmonary Division at Washington University. In the second area, we have continued to study gallium-68 labeled radiopharmaceuticals and have carried out the work to allow gallium-68 labeled macroaggregated albumin to be administered to patients. This was necessary due to the fact that our previous gallium-68 particulate tracer, gallium-68 labeled microspheres could not be prepared due to the fact that the microsphere kit from 3M was removed from the market. In the area of labeled antibodies we have studied indium-111 labeled antibodies in two animal models and compared gallium-68 labeled antibodies with indium and iodine antibodies in one of these models. It appears that gallium-68 labeled antibody fragments may have promise as radiopharmaceuticals.

40673 (DP-MS–89-59) **Decontamination technology overview (U).** Rankin, W.N.; McGlynn, J.F. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890854–1: 11. annual DOE low level waste management conference, Pittsburgh, PA (USA), 22-24 Aug 1989). Order Number DE89013716/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper consists of an overview of the decontamination technology program being carried out at the Savannah River Site and discusses the use of state-of-the-art equipment and techniques for decontamination and removal (D&R) applications. The purpose of the program is to minimize personnel radiation exposure, minimize the potential for uptake of radioactive material, and reduce the volume of contaminated waste. Implementation of technology and the status of new applications are discussed. 6 refs., 34 figs.

40674 (IPNO-T–89-03) **Study of lifetimes of fluorescence levels of tetravalent uranium in the incommensurate phase of thorium tetrabromide and tetrachloride.** Milicic, A. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Paris-11 Univ., 91 - Orsay (France). 1989. 181p. Order Number DE89903306/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The lifetimes of radiative levels of tetravalent uranium in the incommensurate phase of thorium tetrahalides have been measured as a function of different parameters: site symmetry, temperature and concentration. The incommensurate phase of thorium tetrabromide and tetrachloride is characterized by a continuous distribution of site symmetries induced by a continuous and weak displacement of the halides around the thorium (uranium) ions. At low temperature, 4.2 K, the lifetime variation as a function of excited classes of symmetry is governed by the radiative process probability as well as the energy transfer between uranium ions in different sites. At higher temperature, a model based on a Boltzmann equilibrium between closed energy levels is able to reproduce the experimental lifetime variation as a function of the temperature, for a given class of symmetry. For the variation of lifetime as a function of uranium ion concentrations, at high dilution and in the case of U^{4+}: $ThBr_4$, there is a competition between the energy transfer and thermal population of excited states.

40675 (LA–11620-PR) **Isotope and Nuclear Chemistry Division annual report, FY 1988: Progress report, October 1987–September 1988.** Los Alamos National Lab., NM (USA). Jun 1989. 114p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. Order Number DE89014361/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report describes some of the major research and development programs of the Isotope and Nuclear Chemistry Division during FY 1988. The report includes articles on weapons chemistry, biochemistry and nuclear medicine, nuclear structure and reactions, and the INC Division facilities and laboratories.

40676 (LBL–27314) **Tellurium-118/antimony-118 generator.** Yano, Y.; Lagunas-Solar, M. Lawrence Berkeley Lab., CA (USA). Jun 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890680–1: 36. annual meeting of the Society of Nuclear Medicine, St. Louis, MO (USA), 13-16 Jun 1989). Order Number DE89015225/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This research develops a radioisotope generator to obtain ^{118}Sb (3.5 m half-life, 75% positrons) from the 6.0 d ^{118}Te parent. About 2 mCi of ^{118}Te was produced per run. Gamma ray analysis with a GeLi detector indicated the production of $^{118}Te/^{118}Sb$, ^{120}Sb, ^{122}Sb, $^{119}Te/^{119}Sb$, $^{119m}Te/^{119}Sb$, ^{121}Te, and ^{121m}Te. The Sb target was brought into solution with HCl and HNO_3 acid. Six % sodium tartrate was added to the target solution to form the Sb-tartrate complex for loading onto an inorganic ion exchange column of neutal alumina (Al_2O_3) and SnO_2. Six % sodium tartrate at various pH's ranging from 2 to 8 were used as the eluent solutions. Elution yields of ^{118}Sb and breakthroughs of Te radioisotopes were determined by dose calibrator measurements and GeLi analysis. Results indicate that the ^{118}Sb yield at pH 7.0 from the SnO_2 was twice the yield from Al_2O_3 with 6% tartrate, while the breakthroughs of Te radioactivity were nearly comparable for the two columns. However, elutions with 6% tartrate at pH 3.5 doubled the yield of ^{118}Sb from Al_2O_3 while elutions at pH 3.5 from SnO_2 increased the ^{118}Sb yield about 28%. Cumulative elution volumes of 6% tartrate at pH 7.0 from either Al_2O_3or SnO_2led to a gradual reduction in ^{118}Sb yield from about 25% down to 5-6%. Elutions at pH 3.5, led to a higher yield without a gradual reduction in yield with cumulative elution volumes of 6% tartrate. A pH of 5.0 was finally chosen as the best compromise between sustained levels of {118}Sb yield and the biological and chemical advantages of working at a pH higher than 3.5. Exchange labeling was used to label thio compounds with the ^{118}Sb-tartrate from the generator.

40677 (NSS/R–116) **Experimental measurements of the solubilities of selected long-lived fission products, activation**

products and actinide daughters under high pH conditions. Pilkington, N.J.; Shadbolt, P.J.; Wilkins, J.D. United Kingdom Nirex, Ltd., Harwell (UK). May 1988. 21p. (ILWRP–87-P7). Order Number DE89632606/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Solubility measurements of several elements have been attempted under high pH and oxic conditions in a range of concrete leachates. The elements investigated were niobium, tin, selenium, lead and thorium. (author).

40678 (PtUB–21, pp. 293-308) **Electroflotation of uranium and optimization of the precipitate flotation of actinides by means of cationic tensides.** Heckmann, K. (Regensburg Univ. (Germany, F.R.)); Rieger, C.; Strnad, J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN). Apr 1988. (In German). Contract BMFT 02 U 5685. (CONF-8801167–: Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 29-30 Jan 1988). In *PtUB reports. Proceedings of the 1987 status seminar of the project management of university research on subjects of the nuclear fuel cycle.* Available from Copy held by UB/TIB Hannover.

With the help of electroflotation (the electrolytic establishment of valency combined with precipitate flotation), cerium(IV) was separated under anodic conditions with a cationic tenside from U(VI), which remains dissolved, can be reduced and again precipitated with a cationic tenside, and can be separated under cathodic conditions. To separate actinides by means of precipitate flotation, the solubility of tensides (pyridinium salts) and their salts was determined with thorium and dissociation constants of hexanitrato complexes in solutions containing nitrate, the aim being to obtain optimum conditions for the separation of Pu from MAW solutions. (RB).

4008 Combustion, Pyrolysis, and High-temperature Chemistry

Refer also to citation(s) 39868, 39921, 40112, 40410, 40849

40679 (CONF-8905105–3) **Bifurcation analysis of condensed-phase surface combustion.** Garbey, M.; Kaper, H.G.; Leaf, G.K.; Matkowsky, B.J. Argonne National Lab., IL (USA). 28 Nov 1988. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 3. international conference on numerical combustion; Antibes (France); 23-26 May 1989. Order Number DE89015691/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this article we are concerned with the structure and stability properties of a combustion front propagating along the surface of a cylindrical solid fuel element. The fuel consists of a mixture of two finely ground metallic powders, which combine upon ignition in a one-step chemical reaction to form a solid combustion product. The chemical reaction is accompanied by a melting process, where the reaction-limiting component melts at a temperature close to the adiabatic temperature. The adiabatic temperature itself is less than the melting temperature of the combustion product. The melting process reinforces the chemical reaction by increasing the surface contact area between the metallic powders, thus enhancing the reaction rate. The heat of fusion is added to the heat of reaction, so the combustion product is in the solid state. The activation energy of the chemical reaction is typically large, so we assume that the entire reaction zone, inside which melting occurs, is effectively reduced to a front that propagates along the cylinder. 9 refs., 9 figs.

40680 (DOE/CE/90213–T1) **Particulate and droplet diagnostics in spray combustion: Annual report and program plan.** Semerjian, H.G. National Inst. of Standards and Technology, Gaithersburg, MD (USA). Chemical Process Metrology Div. Nov 1986. 45p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-86CE90213. Order Number DE89015147/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this project is to investigate droplet evaporation, combustion and particulate formation processes in spray flames, using nonintrusive diagnostic techniques, and to delineate the effect of chemical and physical properties of liquid fuels on the above processes. The results of this study will provide an experimental data base, with well-defined boundary conditions, for the development and validation of spray combustion models. These models, in turn, can be used to develop computerized design methodologies, to predict combustor performance over a wider range of operating parameters, and to predict the effect of variations in fuel properties on combustion efficiency, radiative energy transfer, and pollutant emissions. 57 refs., 18 figs., 2 tabs.

40681 (DOE/CE/90213–T2) **Particulate and droplet diagnostics in spray combustion: Annual report and program plan.** Semerjian, H.G. National Inst. of Standards and Technology, Gaithersburg, MD (USA). Chemical Process Metrology Div. Mar 1988. 31p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-86CE90213. Order Number DE89015148/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this project is to investigate droplet evaporation, combustion and particulate formation processes in spray flames, using nonintrusive diagnostic techniques, and to delineate the effect of chemical and physical properties of liquid fuels on the above processes. The results of this study will provide an experimental data base, with well-defined boundary conditions, for the development and validation of spray combustion models. These models, in turn, can be used to develop computerized design methodologies, to predict combustor performance over a wider range of operating parameters, and to predict the effect of variations in fuel properties on combustion efficiency, radiative energy transfer, and pollutant emissions. 44 refs., 6 figs., 2 tabs.

40682 (DOE/CE/90213–T3) **Particulate and droplet diagnostics in spray combustion: Annual report.** Semerjian, H.G.; Presser, C. National Inst. of Standards and Technology, Gaithersburg, MD (USA). Chemical Process Metrology Div. Apr 1989. 41p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-86CE90213. Order Number DE89015149/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this project is to investigate droplet evaporation, combustion and particulate formation processes in spray flames, using nonintrusive diagnostic techniques, and to delineate the effect of chemical and physical properties of liquid fuels on the above processes. During previous phases of this project, the design and fabrication of the variable swirl burner was completed, and the operating characteristics were evaluated over a wide range of operating conditions. Photography, high speed cinematography, and laser sheet beam scattering techniques were used to identify various regions of the spray flame, and to observe trajectories of large droplets and overall features of the flame. Complete data sets on a kerosene spray have also been obtained with both a pressure atomizer and an air-assist nozzle. 58 refs., 9 figs., 2 tabs.

40683 (LBL–27183) **Minutes of the workshop on premixed turbulent combustion.** Cheng, R.K.; Shepherd, I.G. (eds.). Lawrence Berkeley Lab., CA (USA). Dec 1988. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8808254–Summ.: Workshop on premixed turbulent combustion, Berkeley, CA (USA), 22-23 Aug 1988). Order Number DE89014888/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The workshop on premixed turbulent combustion was held at Lawrence Berkeley Laboratory, Berkeley, California, on August 22 and 23, 1988, and was scheduled to follow the 22nd International Combustion Symposium in Seattle, Washington, to attract domestic and international participants. The purpose of the workshop was to provide a forum for a focused group of theoretical and experimental researchers active in the field of premixed turbulent combustion research to discuss freely the current status and the future goals and directions of their programs. Thirty investigations were sent together with questionnaires to solicit suggestions for discussion topics and for the agenda (Appendix 1). Eighteen responses were received, and the answers to the questionnaire were categorized, summarized (Appendix 3), and distributed to most of the participants prior

to the workshop. Based on the answers to the questionnaire, four discussion topics were selected for the sessions (Appendix 4). They were (1) Regimes of premixed combustion, (2) Comparison between experiments and models, (3) From laboratory to real flames, and (4) General open discussion.

42 ENGINEERING

Refer also to citation(s) 40340

40684 (DNE–9015032-Pt.2A) **National Register of Research Projects, 1986/87: Part 2A, Natural sciences: Physical, engineering and related sciences (modified projects).** Department of National Education, Pretoria (South Africa). Aug 1988. 127p. (In Afrikaans, English). Order Number DE89015032/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI.

This Register is intended to serve as a source of information on research which is being conducted in all fields (both natural and human sciences) in the Republic of South Africa. New and current research projects that were commenced or modified during 1986 and 1987, on which information was received by the compilers until January 1988, are included, with the exception of confidential projects. Project titles and keywords are presented in the language as supplied, and the classifications are based on those provided by the primary sources.

4202 Facilities and Equipment

Refer also to citation(s) 39808, 39912, 39931, 39935, 39941, 39943, 39976, 40009, 40020, 40030, 40035, 40071, 40167, 40178, 40302, 40487, 41015, 41056

40685 (CEA-DAS–575) **Specification of test criteria and probabilistic approach: the case of plutonium air transport.** Hubert, P.; Pages, P.; Ringot, C.; Tomachewsky, E. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Mar 1989. 6p. (CONF-870820–: PSA 87: international topical meeting on probabilistic safety assessment and risk management, Zurich (Switzerland), 31 Aug - 4 sep 1987). Order Number DE89903180/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The safety of international transportation relies on compliance with IAEA regulations which specify a serie of test which the package is supposed to withstand. For Plutonium air transport some national regulations are more stringent than the IAEA one, namely the US one. For example the drop test is to be performed at 129 $m.s^{-1}$ instead of 13.4 $m.s^{-1}$. The development of international Plutonium exchanges has raised the question of the adequacy of both those standards. The purpose of this paper is to show how a probabilistic approach helps in assessing the efficiency of a move towards more stringent tests.

40686 (CEA-DAS–576) **Action taken by the french safety authorities for fire protection and fire fighting in basic nuclear plants.** Savornin, J.; Gibault, M.; Berger, R.; Kaluzny, Y.; Wallard, H.E.; Winter, D. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Mar 1989. 12p. (CONF-890203–: International symposium on fire protection and fire fighting at nuclear installations, Vienna (Austria), 27 Feb - 3 mar 1989). Order Number DE89903188/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The safety goal for nuclear installations is to prevent the dispersal of radioactive substances, both in the work area and outside the buildings into the environment. It is therefore at the design stage, then during construction and subsequent operation that it is necessary to take preventive measures against the outbreak of fire, and to take precautions to ensure that the consequences will always be limited. The paper describes the arrangements made by the French safety authorities to provide protection against fire in both nuclear plants and nuclear fuel cycle installations at all these stages.

40687 (CONF-890888–1) **Research in mobile robotics at ORNL/CESAR [Oak Ridge National Laboratory/Center for Engineering Systems Advanced Research].** Mann, R.C.; Weisbin, C.R.; Pin, F.G. Oak Ridge National Lab., TN (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From IEEE international conference on systems engineering; Dayton, OH (USA); 24-26 Aug 1989. Order Number DE89013052/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper reviews ongoing and planned research with mobile autonomous robots at the Oak Ridge National Laboratory (ORNL), Center for Engineering Systems Advanced Research (CESAR). Specifically we report on results obtained with the robot HERMIES-IIB in navigation, intelligent sensing, learning, and on-board parallel computing in support of these functions. We briefly summarize an experiment with HERMIES-IIB that demonstrates the capability of smooth transitions between robot autonomy and tele-operation. This experiment results from collaboration among teams at the Universities of Florida, Michigan, Tennessee, and Texas; and ORNL in a program targeted at robotics for advanced nuclear power stations. We conclude by summarizing ongoing R&D with our new mobile robot HERMIES-III which is equipped with a seven degree-of-freedom research manipulator arm. 12 refs., 4 figs.

40688 (EUR–12050) **Study of the impact behaviour of packages containing intermediate level radioactive waste coming from nuclear installations.** Davis, D.; Lund, J.S.; Meredith, P.; Walker, P.; Wells, D.A.; Jowett, J.; Kinsella, K. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 76p. Available from NTIS (US Sales Only), PC A05/MF A01.

The following describes primarily an experimental study into the benefits, for impact resistance, to be gained by incorporating a welded lid into the design of the cement filled drum type of intermediate level waste package. Tests on packages which were not provided with a lid showed that matrix material began to be expelled from drop heights of about 16m. This damage threshold was similar for packages composed of both high and low strength matrix. Above the damage threshold, however, the rate of increase of expelled mass with drop height was greater for the packages filled with a low strength matrix. Similar tests were conducted with specimens to which a lid had been attached by welding. Even from the greatest drop height available at the test facility (28m) only one package showed a significant amount of drum tearing but even then little matrix was lost. The benefits of incorporating a welded lid into package design were thus clearly established. Simple calculations were performed to predict the local deformations and deceleration/time histories of the packages. By optimisation of the impact resistive stress used in the computer model, final knockback areas were predicted to an accuracy of 30%. The average deceleration predicted for four of the six tests for which deceleration histories were available were also within 30% of measured values.

40689 (GA-A–19415) **Development of honeycomb impact limiters.** Koploy, M.A.; Taylor, C. General Atomics, San Diego, CA (USA). Jun 1989. 11p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC07-88ID12698. (CONF-890631–57: International symposium on packaging and transporting of radioactive materials, Washington, DC (USA), 11-16 Jun 1989). Order Number DE89014251/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

General Atomics (GA), has a contract with DOE's Office of Civilian Radioactive Waste Management (OCRWM) to develop two legal weight truck casks to transport spent fuel. The GA-4 and GA-9 Casks transport four pressurized-water-reactor (PWR) and nine boiling-water-reactor spent fuel assemblies respectively. The GA-4 and GA-9 Casks preliminary designs include honeycomb impact limiters on the top and bottom of the cask bodies to protect them during any normal transport or hypothetical accident drop onto an unyielding surface. To evaluate the response of the cask during a drop, we need load vs deflection curves for the impact limiters at different impact angles. To obtain these curves, we made a solid model of an impact limiter with a geometry modeling computer code. We used a plane to cut through the model and obtain the footprint of the impact limiter as it crushes. As honeycomb sections are oriented in different directions in the impact limiter, we calculated the crushed areas for each individual section. Each section was then assigned a crushing force that varied from the nominal honeycomb crush strength.

40690 (GA-A–19703) **GA-4 and GA-9 legal weight truck shipping cask development.** Meyer, R.J.; Grenier, R.M.; Jensen, M.F. General Atomics, San Diego, CA (USA). Jun 1989. 9p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC07-88ID12698. (CONF-890631–58: International symposium on packaging and transporting of radioactive materials, Washington, DC (USA), 11-16 Jun 1989). Order Number DE89014247/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

General Atomics (GA), under contract to the Idaho Operations Office of the US Department of Energy, is developing two new legal weight truck spent fuel shipping casks that will carry four PWR or nine BWR spent fuel assemblies. They are being developed for the Office of Civilian Radioactive Waste Management (OCRWM) to meet its mission to dispose of nuclear wastes at a permanent disposal site. Our primary goal is to maximize the number of fuel elements of each fuel type that a LWT cask can carry, while ensuring that the design meets all NRC licensing requirements. 4 figs.

40691 (INIS-SU–95, pp. 33-37) **Contact arc cutting of worked-out equipment.** Murav'ev, V.F.; Gor'kov, L.V.; Ozolin, A.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). In *Welding in nuclear technology. Scientific-technical collection.* Order Number DE89012167/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 1(20).

Possibility of using contact-arc (electrocontact) cutting for division worked-out equipment is considered. Installations, designated for cropping such equipment are described. 2 refs.; 5 figs.; 1 tab.

40692 (IPNO-T–89-01) **Study and development of a high resolution β minus radio imager.** Charon, Y. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Paris-11 Univ., 91 - Orsay (France). 1989. 98p. (In French). Order Number DE89903222/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Charge coupled device (C.C.D.), have already been used to track charged particle beams. We now present another application which combines this sensor with a light-amplifier to develop an imaging detector. This image sensor must detect various β^- emittors, at very low counting rates. Furthermore it must perform a 10 μm resolution in order to replace the autoradiograpic films used for molecular hybridization. The first tests were performed on this first configuration (uncooled light amplifier, NE 102 sheets, 60 mm^2 analysis surface). This tests brought forward the light yield and intrisic resolution for various plastic thickness, and for each of the three usual β^- emittors: ^{35}S, ^{32}P, ^{3}H. We have then proceeded to modifications: increasing photocathode's sensibility, cooling L.A., trying various scintillating plastics, using various software discrimination techniques. These modifications were gradually and succesfully introduced and the best results were obtained with the ^{35}S emittor, for which the resolution and the efficiency are respectively 15 μm and 99% (relative to the measured standard sources). Right now, the detector is good enough to produce images of biological slides with nearly the requested resolution and an efficiency more than three thousands times greater than films. Nevertheless, in order to propose the most valuable product, it is necessary to trig the C.C.D. with a coincidence signal, to increase the photocathode sensibility down to the U.V.. All those parameters have been integrated in a new prototype design and will be tested after this publication.

40693 (LA-UR–89-1636) **Axially accelerated saboted rods subjected to lateral forces.** Rabern, D.A. Los Alamos National Lab., NM (USA). 1989. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890885–2: Flash radiography topical symposium, Portland, OR (USA), 15-18 Aug 1989). Order Number DE89012612/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Considerable effort has been dedicated to ensuring the structural integrity of long rods during axial acceleration, but little work has addressed the subject of lateral acceleration of the sabot/rod package while it is still in-bore. Drysdale states "Certainly the most pressing unsolved problem facing the projectile designer at the present time does not involve structural integrity directly. Rather it is the development of a methodology which allows the rational design of in-bore configurations so that balloting and sabot separations have a minimal effect on the flight of the subprojectile." Characterization of the response of sabot/rod systems to lateral loading is the next fundamental step to improving sabot designs. Benchmarked analyses and methodology will provide projectile designers with both quantitative and qualitative information to characterize the structural integrity of sabots that are subjected to lateral loads during launch. 10 refs., 12 figs.

40694 (LA-UR–89-2301) **ROBOCAL: Gamma-ray isotopic hardware/software interface.** Hurd, J.R.; Bonner, C.A.; Ostenak, C.A.; Morrison, R.E.; Staley, H.C.; Fleissner, J.G.; Coressel, T.W.; Yee, D.C. Los Alamos National Lab., NM (USA). 1989. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–55: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015271/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

ROBOCAL, presently being developed at the Los Alamos National Laboratory, is a full-scale prototypical robotic system for remotely performing calorimetric and gamma-ray isotopics measurements of nuclear materials. It features a fully automated vertical stacker-retriever for storing and retrieving packaged nuclear materials from a multi-drawer system, and a fully automated, uniquely integrated gantry robot for programmable selection and transfer of nuclear materials to calorimetric and gamma-ray isotopic measurement stations. Since ROBOCAL is to require almost no operator intervention, a mechanical control system is required in addition to a totally automated assay system. The assay system must be a completely integrated data acquisition and isotopic analysis package fully capable of performing state-of-the-art homogeneous and heterogeneous analyses on many varied matrices. The TRIFID assay system being discussed at this conference by J. G. Fleissner of the Rocky Flats Plant has been adopted because of its many automated features. These include: MCA/ADC setup and acquisition; spectral storage and analysis utilizing an expert system formalism; report generation with internal measurement control printout; user friendly screens and menus. The mechanical control portion consists primarily of two detector platforms and a sample platform, each with independent movement. Some minor modifications and additions are needed with TRIFID to interface the assay and mechanical portions with the CimRoc 4000 software controlling the robot. 6 refs., 5 figs., 3 tabs.

40695 (LBL–27103) **X-ray microprobe studies using multilayer focussing optics.** Thompson, A.C.; Underwood, J.H.; Wu, Y.; Giauque, R.D.; Rivers, M.L.; Futernick, R. Lawrence Berkeley Lab., CA (USA). Aug 1988. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8808126–2: 37. annual applications of analysis x-ray conference, Steamboat Springs, CO (USA), 1-5 Aug 1988). Order Number DE89015224/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The availability of intense x-rays from synchrotron radiation sources permits the elemental analysis of samples in new ways. An x-ray microprobe using these sources allows the analysis of much smaller samples with greatly improved elemental sensitivity. In addition to the higher x-ray intensity obtained at synchrotron sources, the development of high efficiency x-ray reflectors using multilayer coated optical mirrors permits the achievement of spot sizes of less than 10 μm x 10 μm with enough x-ray intensity to simultaneously measure femtogram quantities of many elements in less than one minute. Since samples to be studied in an x-ray microprobe do not have to be placed in a vacuum, almost any sample can be conveniently analyzed. With an x-ray microprobe it is possible to obtain elemental distributions of elements in one, two or even three dimensions. In an x-ray microprobe a beam of x-rays is either collimated or focussed to a fine spot which is then scanned over the specimen. The characteristic fluorescent x-rays excited in the specimen are then detected using an energy or wavelength dispersive detector. In our system we use a synchrotron radiation x-ray beam as the source of x-rays, a pair of multilayer mirrors to focus the x-rays, and a Si(Li) detector to measure the fluorescent x-rays. It allows us to simultaneously measure the concentration of elements from K to Zn with a sensitivity of better than 50 fg in 60 sec. 6 refs., 4 figs.

40696 (PNL-SA-16233) **Defense Waste Processing Facility canister impact testing.** Olson, K.M.; Alzheimer, J.M. Pacific Northwest Lab., Richland, WA (USA). Mar 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. (CONF-8903112--4: Waste management '89, Tucson, AZ (USA), 1 Mar 1989). Order Number DE89015328/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Materials Characterization Center at Pacific Northwest Laboratory (PNL) has drop tested seven Defense Waste Processing Facility high-level waste canisters for Savannah River Laboratory (SRL) (1). The canisters were filled with simulated waste glass to ~85% capacity and sealed by SRL before being shipped to PNL. Each 304L stainless steel canister was approximately 300 cm (9 ft 10 in.) long, and 61 cm (2 ft) in diameter, and weighed approximately 2150 kg (4740 lb). Each canister was dropped 7 m (23 ft) in two orientations. In the first drop, the canister was oriented vertically to hit the impact pad bottom-first with the canister bottom parallel to the pad. In the second drop, the canister was oriented with its center of gravity over the shoulder corner, and was dropped top-first, hitting the impact pad at an angle. Examinations were performed on the canisters before and after each drop to evaluate the results of each drop independently. Procedures used to examine the canisters were the application and analysis of strain circles, helium leak testing, dye penetrant examination, and canister measurements. Little deformation was observed after the bottom drops. The top drops caused the greatest effect on canister dimensions and apparent strain. Height decreased by 14.0 to 16.4 cm or approximately 5%. The largest deformations occurred where the neck of the canister meets the body on the impact side and 180° away from this point. Strain circles showed strain ranging from 52% compressive to 8% tensile. 2 refs., 7 figs., 3 tabs.

40697 (SAND-87-7120) **Analysis and construction of contact and tactile sensors.** Salisbury, K.; Hollerbach, J.; Brock, D.; Siegel, D. Massachusetts Inst. of Tech., Cambridge, MA (USA). Artificial Intelligence Lab. Jul 1989. 35p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE89013992/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During the period of June 1, 1987 through May 31, 1988, the preliminary analysis and construction of two radically different touch sensors was performed at the MIT AI Laboratory. The sensors investigated during the course of this contract provide complementary means for a robot finger to perceive information about contact with an object. The sensor developed by Siegel is a miniature array of 64 pressure sensitive elements which employ a capacitance measuring scheme to achieve good linearity and resolution in measurement of the normal force at each element. The other sensor, developed by Brock employs an entirely different technique for sensing contact. It uses a rigid, hollow fingertip mounted on a force sensing structure to measure contact information. The structure employs strain gauges to permit the measurement of all six components of the net force acting on the fingertip.

40698 (SAND-87-7150) **Sensor-driven robot control and mobility: Final report.** Starr, G.P. Sandia National Labs., Albuquerque, NM (USA). May 1989. 54p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89013874/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The work performed under contract 57-2312 which is presented in this Final Report consists of the following tasks: Continued development of the UNM/SNL controller for the dexterous hand, and evaluation of this controller in a demonstration assembly task. This is the first documented use of a dexterous hand in an actual assembly task; Development of the necessary theory for effective fingertip force calculation when using the dexterous hand to manipulate an object. This theory, unlike previous formulations, makes use of internal force to prevent the fingers from sliding or breaking contact; ongoing development of the controller for the Adept-2 pedestal robot. The effort here has primarily been in identifying an appropriate waveform for commutation of the NSK direct-drive variable-reluctance motor. We have developed a simulation of the motor, which aids in waveform synthesis.

40699 (SAND-88-3279C) **Orientable insertions.** Strip, D.R. Sandia National Labs., Albuquerque, NM (USA). 6 Dec 1988. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890843--2: International symposium of robotics research, Tokyo (Japan), 28-31 Aug 1989). Order Number DE89006232/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Automatic programming of insertions is an essential step in achieving a truly flexible manufacturing environment. We present a force-directed strategy which is capable of inserting a wide variety of shaped pegs. Analysis of the forces encountered during insertion proves that this strategy will insert any convex peg. Experimental results of implementation of this strategy using both hybrid force-position control and a new passive mechanism are included. 10 refs., 13 figs.

40700 (SAND-89-0053C) **An alternative control structure for telerobotics.** Boissiere, P.T.; Harrigan, R.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890843--1: International symposium of robotics research, Tokyo (Japan), 28-31 Aug 1989). Order Number DE89006509/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses a new telerobotic control concept which couples human supervisory commands with computer reasoning. The control system is responsive and accomplishes an operator's commands while providing obstacle avoidance and stable controlled interactions with the environment in the presence of communication time delays. This provides a system which not only assists the operator in accomplishing tasks but modifies inappropriate operator commands which can result in safety hazards and/or equipment damage. Research and development of this concept is being carried out in the Telerobotics Research Laboratory at Sandia National Laboratories. 12 refs., 4 figs.

40701 (SAND-89-0540C) **Sandia National Laboratories proof-of-concept robotic security vehicle.** Harrington, J.J.; Jones, D.P.; Klarer, P.R.; Morrow, J.D.; Workhoven, R.M.; Wunderlin, F. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890889--3: 5. annual symposium on technical displays on physical and electronic security, Philadelphia, PA (USA), 15-17 Aug 1989). Order Number DE89014478/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Several years ago Sandia National Laboratories developed a prototype interior robot that could navigate autonomously inside a large complex building to air and test interior intrusion detection systems. Recently the Department of Energy Office of Safeguards and Security has supported the development of a vehicle that will perform limited security functions autonomously in a structured exterior environment. The goal of the first phase of this project was to demonstrate the feasibility of an exterior robotic vehicle for security applications by using converted interior robot technology, if applicable. An existing teleoperational test bed vehicle with remote driving controls was modified and integrated with a newly developed command driving station and navigation system hardware and software to form the Robotic Security Vehicle (RSV) system. The RSV, also called the Sandia Mobile Autonomous Navigator (SANDMAN), has been successfully used to demonstrate that teleoperated security vehicles which can perform limited autonomous functions are viable and have the potential to decrease security manpower requirements and improve system capabilities. 2 refs., 3 figs.

40702 (UCRL-100358) **Commercial high current ignitron development.** Kihara, R.; Cummings, D.B.; Leighton, K.S.; Shulski, A.P. Lawrence Livermore National Lab., CA (USA). Jun 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890665--36: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89015077/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our overall goal is to develop and qualify devices capable of repetitively switching high peak currents (>1 MA) and large quantities of charge (>500 C). In 1988 we designed and tested a hollow-anode ignitron at levels of up 925 kA and 260 C per shot. This level is three times that previously achieved with standard,

commercially available tubes. Our latest designs, developed with the cooperation on industry, incorporate a hollow anode into an industrial ignitron. Prototypes have recently achieved levels of 770 kA and 270 C per shot. 4 refs., 6 figs., 1 tab.

4203 Lasers

Refer also to citation(s) 40505, 40556, 40561, 40727, 40769, 40833, 40842, 41014, 41055, 41056, 41058, 41060, 41064, 41067, 41069, 41070, 41152, 41153, 41375

40703 Short wavelength coherent radiation: Generation and applications: Proceedings: Volume 2. Falcone, R.W.; Kirz, J. 436p. Optical Society of America, Washington, DC (1988). Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13887. From 4. topical meeting on short wavelength coherent radiation: generation and applications; North Falmouth, MA (USA); 26-29 Sep 1988.

The Fourth Topical Meeting on Short Wavelength Coherent Radiation: Generation and Applications was held in North Falmouth, Massachusetts, September 26–29, 1988. This volume is a record of the exciting research presented at the conference. The most recent previous conferences in this series were held in Monterey, California (1986) and Boulder, Colorado (1984 and 1982). The meeting brought together 164 participants, including scientists from Australia, Austria, Canada, China, England, France, Germany,Japan, the Soviet Union, Sweden, and the United States. It is a reflection of the continuing growth in the areas covered by the conference that the attendance at the meetings continues to grow and that the number of contributed papers grows even faster. This made it necessary to schedule many of the contributions for a particularly lively poster session that lasted far past its scheduled end at 10:00 pm. Most of the conference was devoted to new results on short wavelength lasers. Progress in short wavelength synchrotron sources and nonlinear-optics techniques was also reported. Theoretical and experimental research was presented to describe the coupling of intense lasers with matter and the study of multiphoton and above-threshold ionization. A session was devoted to the remarkable coherence properties of nuclear Bragg- scattered radiation. In the applications area, new results were presented on x-ray optics, microscopy, holography, and spectroscopy.

40704 Improved performance of the Aurora front end using a phase conjugate mirror. Thomas, S.J. (Los Alamos National Lab., Los Alamos, NM (US)); Hosack, K.W.; Lopez, L.J.; Bigio, I.J.; Kurnit, N.A. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

Stimulated Brillouin scattering (SBS) phase conjugate mirrors have been used to improve the output of KrF lasers. The authors describe here the application of a phase conjugate mirror to the Aurora inertial confinement fusion (ICF) laser system. They believe this to be the first practical application of phase conjugating elements to a large laser system. The front end system of Aurora takes advantage of commercially available units, which are then appropriately modified. A Lambda Physik model EMG 150 KrF laser which contains two discharge heads (used as oscillator and preamplifier) and two Lumonics model 292 amplifiers comprise the main components of this front end. The experimental layout is shown schematically. The oscillator cavity, which consists of a 10-m concave high-reflectivity mirror and a 60% R flat output coupler separated by 1.25 m with a 1-mm intracavity aperture, was run with a moderate amount of dispersion provided by a single prism) resulting in a bandwidth of –10 cm^{-1}). The 10-mJ 20-ns pulse from the oscillator is optically delayed by 20- ns to compensate for the built-in delay between the two discharge heads of the Lambda Physik device.

40705 Impulse coupling to targets in vacuum by KrF, HF, and CO_2 single pulse lasers. Phipps, C.R. Jr. (Los Alamos National Lab., Chemical and Laser Sciences Div., Los Alamos, NM (US)); Harrison, R.F.; Turner, T.P.; Anderson, G.K.; Haynes, L.C. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

The authors review a scaling model which permits approximate prediction of the dependence of ablation pressure, mechanical coupling coefficient, and related parameters in vacuum on single pulse laser intensity I, wavelength λ, and pulse width tau over extremely broad ranges. The model is valid for the intensity above the plasma ignition threshold and for metallic and nonmetallic endothermic surface-absorbing planar targets. The data supporting this trend represent intensities from 3 MW/cm^2, pulse widths from 1.5 ms to 500 ps, wavelengths from 10.6 μm to 248 nm, and pulse energies from 100 mJ to 10kJ. Sources for the data range from studies of accelerating thin foils at laser fusion intensities to several years of Los Alamos work on vacuum laser impulse coupling. The authors also discuss several exceptions to this predictive agreement which they have observed with targets which absorb laser light in-depth or with exothermic (cellulose nitrate) targets. In the latter case, at 10.6 μm, they observed mechanical coupling coefficients as large as 33.4 dyn/W at tau=700 ns, I=25 MW/cm^2 (the peak coupling intensity). Together, these results suggest the possibility of very simple scaling estimates of pressure and coupling in vacuum for intensities above the plasma threshold.

40706 Mode control in broad-area diode lasers by lateral index tailoring. Hadley, G.R. (Sandia National Labs., Albuquerque, NM (US)); Hohimer, J.P.; Owyoung, A. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

These studies suggest that lateral index profiling in the structure of broad area lasers may provide an effective means of realizing control of modal emission in these devices. Junction heating has been shown to have a dominant effect on the modal emission characteristics of gain-guided diode laser arrays and broad-area devices. To examine the sensitivity of the modal emission in a broad-area diode laser to variations in the lateral thermal profile in the junction plane, the authors focused laser radiation from an argon-ion laser (488 nm) onto the rho-side metallization of a 60-μm wide oxide-stripe broad-area laser mounted rho-side up.

40707 Long-life maintenance-free excimer lasers. Tennant, R.A. (Los Alamos National Lab., Los Alamos, NM (US)); Anderson, R.G.; Menegat, A.A. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

The use of excimer lasers is often limited by an output power that decreases quickly with time. This decrease in output power is caused primarily by relatively short optic and gas lifetimes due to halogen-material interactions. As a result, the interaction of common structural materials with HCl and F_2 is being studied. The goal of the study is either to stabilize the current materials to HCl or F_2 attack or to find better materials. Current laser materials include Viton O-rings, Kynar, aluminum, nickel-plated aluminum, pure nickel, and stainless steel. In addition, current foil materials used in KrF e-beam lasers include titanium, aluminum, and inconel. A series of experiments have evaluated the halogen-material interactions of the above materials. The approach taken with structural materials was to construct spectrophotometer cells out of each material to fill the cells (at room temperature) with an HCl or F_2 containing gas and to monitor gas composition as a function of time with an IR spectrophotometer. The e-beam foils were tested on a small e-beam test facility which produced a current density of 18 A/cm^2, a voltage of 300 kV, and a pulse width of 500 ns. Gas samples were analyzed on UV and IR spectrophotometers.

40708 Wavefront modification and beam pointing by Bragg scattering from a volumetric thermal phase grating. Kurnit, N.A. (Los Alamos National Lab., Los Alamos, NM (US)); Sklar, E.L.; Telle, J.M.; Thomas, S.J.; Watkins, D.E.; Goldhar, J. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

A KrF laser beam is split using a zero-path-difference Michelson interferometer and relay imaged into a 4-cm long absorption cell containing CF_3I. Although this configuration is somewhat wasteful of writing-beam energy. It was useful in these experiments because the short coherence length of the 30-cm^{-1} bandwidth KrF laser necessitated making the angle between these beams very small to find the zero-path-difference condition. The adjustable angle between these two beams provides a variably spaced thermally induced phase grating which can be used to deflect another laser beam with high efficiency. Writing angles were of the order of 10 mrad. In these experiments, the probe beam was a low-power cw He-Ne laser. To demonstrate wavefront modification, a phase curvature can be impressed on one of the writing beams by means of a mechanically deformable mirror. In this case, the formerly straight fringes become curved and nonuniformly spaced so that the phase of the deflected beam is altered across its transverse profile to be a (wavelength-scaled) replica of the nonuniform writing beam. One has thereby created a transient volume hologram that efficiently scatters a beam which mimics the writing beam.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 40396, 41074

40709 (CEA-CONF–9745) **Numerical simulation of oscillatory convection in low Prandtl fluids.** Le Garrec, S.; Magnaud, J.P. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 24p. (In French). (CONF-8810408–: GAMM-Workshop, Marseille (France), 12-14 Oct 1988). Order Number DE89903266/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Our participation at the test is limited to a rigid upper surface cavity for a Prandtl number zero. The calculations were effectued for Gr: 20000, 25000 and 30000. Other calculations were realized to study the transition to unstationary conditions.

40710 (LUTEDX-TEEM–1036-1-48-1988) **On ultrasonic flow meters. Investigations and improvements of the sing-around flow meter.** Delsing, J. Lund Univ. (Sweden). Dept. of Electrical Measurement. 16 Dec 1988. 53p. Order Number DE89902411/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The dissertation consists of a general introduction covering the topic of flow measurement using ultrasound methods. Further the following five reports are included: - Viscosity effects in sing-around type flow meter. Investigation and modeling of viscosity and end effects in sing-around type flow meters. - Ultrasonic gas flow meter with corrections for large dynamic metering range. Investigation of a correction algorithm aimed to increase the dynamic metering range of sing-around type flow meters. - A new type of ultrasonic densitometer. Description and investigation of a new technique for the measurement of liquid density. - A new velocity algorithm for sing-around type flow meters. Description and investigation of a new algorithm for the velocity calculation using the sing-around method. - A new ultrasonic flow meter. Modification of the sing-around method for use in heat meter. Design and investigation of a sing-around liquid flow meter.

40711 (NAL–TM-590) **Report on wind tunnel test of redundant airflow direction measurement system with arrow blades.** Kimura, Takeo; Takizawa, Minoru; Uchida, Tadao; Iwasaki, Akito; Fujita, Toshimi. National Aerospace Lab., Chofu, Tokyo (Japan). Jul 1988. 41p. (In Japanese). Order Number DE89772356/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from National Aerospace Laboratory, 7-44-1, Jindaiji-higashi, Chofu, Tokyo, Japan.

Theoretical study on a redundant airflow direction measurement system (3 axis- α/β sensor system), and numerical simulation for error analysis were carreid out. A basic experimental 3 axis- α/β sensor system was made to confirm the measurement principle using a wind tunnel. The accuracy of the preliminary test is reported. Report is made on the comaprison of the results of wind tunnel test and numerial simulation. The measurement principle of this sensor system was verified with a certain accuracy from the results of the test and computation processing. The result shows that the system functions satisfactorily even when one of them has a trouble, although the accuracy may become somewhat lower. This indicates that the system has a measurement accuracy enough for practical use. The problems left for future study are on-line processing of α and β calculation; detection of error and elimination of the signal; and construction of a flight model. 5 references, 33 figures, 21 table.

40712 (NAL–TR-970T) **Mechanisms of secondary flows and losses within a three dimensional turbine stator cascade.** Yamamoto, Atsumasa; Yanagi, Ryoji; Nouse. Hiroyuki. National Aerospace Lab., Chofu, Tokyo (Japan). Apr 1988. 19p. Order Number DE89772310/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from National Aerospace Laboratory. 7-44-1, Jindaiji-higashimachi, Chofu-shi, Tokyo.

To understand mechanism of aerodynamic loss generation by tubine stator cascade, internal flow of low speed three dimensional turbine stator cascade was measured using five-hole Pitot tube. Flow visualization tests and measurement of the static pressure of cascade endwall were made at the same time. The most parts of loss generation in the cascade can be explained as the migration process of low energy boundary layer fluids developed on the flow path wall composed of endwalls on tip and hub sides and blade surfaces onto the blade suction surface at the trailing edges. Pressure gradients are generated in the vicinity. The loss pattern at the blade suction surface has two cores, which are mostly generated by the path vortex on the tip and hub sides. Strong trailing-shedding-vortex occurs at the downstream of cascade, which has complicated effects on the upstream internal flow, such as induction of vortices and redistribution of cascade losses. 9 references, 14 figures, 1 table.

40713 (SAND–89-1301C) **Developing convection above a finite horizontal surface.** Chu, T.Y. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890890–1: 9. international heat transfer conference, Jerusalem (Israel), 19-24 Aug 1989). Order Number DE89012662/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper reports the results of an experimental study of the initiation of convection above a suddenly heated horizontal surface of finite extent. The phenomenon of flow initiation in fluid layers is of both engineering and geophysical interests. The present study is the first that deals specifically with surfaces of finite extent. 8 refs., 6 figs.

40714 **Hybrid finite element-Monte Carlo method for coupled conduction and gas radiation enclosure heat transport.** Kraus, H.G. (Idaho National Engineering Lab., Idaho Falls, ID (USA)). *International Journal for Numerical Methods in Engineering (UK)*, 26(5): 361-378 (May 1988).

A hybrid two-dimensional finite element-Monte Carlo numerical solution method has been developed for solving complex transient non-linear gas radiation enclosure problems. Solid conducting media are coupled to conducting gaseous or particulate participating media and both may be internally energy generating. Bilinear isoparametric elements are used, allowing geometrically complex enclosures with internal objects to be present. Radiative energy transport within the gaseous enclosures is accounted for using a Monte Carlo method which permits a broad range of complexities. Included here are: diffuse-grey and specularly reflecting walls with temperature and spectrally dependent, and non-homogeneous emissivities or absorptivities; absorbing/emitting gases with temperature and spectrally dependent, and non-homogeneous emissivities or absorptivities; and isotropic or anisotropic scattering gases or particles. (author).

4205 Materials Testing

Refer also to citation(s) 40454, 40489, 40579

40715 (INIS-mf–11460) **2. Congress on NDT for Latin America and the Caribbean.** Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. V (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Individual papers in scope for the data base are processed separately. (DLC)

40716 (INIS-mf–11460, pp. 63-80) **Accidents in industrial gamma radiography.** Ramirez Q, R. (Sociedad Peruana de Radioproteccion, Lima (Peru)); Medina G, E. Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

A short analysis on gamma radiography accidents is achieved, concluding with some final remarks and recommendations. As Annex, a list of most important radiation accidents is included.

40717 (INIS-mf–11460, pp. 250-276) **NDT in inspection-repairing of boiler AE-101 of fertilizers Plant-Talara-Peru.** Torres, F. (Petroleos del Peru, Talara (Peru)). Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Experiences got from the use of NDT in inspection-repairing of boiler AE-101 of fertilizers Plant-Talara is presented after failures by pipes breakage. Applying liquid penetrant testing and visual inspection it was possible to determine the seriousness of the equipment the use of metallographic copies, ultrasonic measurements and hardness gave us an idea of the actual condition of the equipment, allowing a safe performance.

40718 (INIS-mf–11460, pp. 398-430) **Digital image processing in NDT : Application to industrial radiography.** Aguirre, J. (Universidad Central de Venezuela, Caracas (Venezuela)); Gonzales, C.; Pereira, D. Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Digital image processing techniques are applied to image enhancement discontinuity detection and characterization is radiographic test. Processing is performed mainly by image histogram modification, edge enhancement, texture and user interactive segmentation. Implementation was achieved in a microcomputer with video image capture system. Results are compared with those obtained through more specialized equipment main frame computers and high precision mechanical scanning digitisers. Procedures are intended as a precious stage for automatic defect detection.

40719 (INIS-mf–11460, pp. 483-497) **NDT in submarines construction-HY 80.** Russo, C.A. (Grupo de Grandes Usuarios Nacionales (Argentina)); Talmadge, J. Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

In submarines construction, provided that metallurgic characteristics have been established, the NDT methods and equipments as well as the application ways should be taken into account. It is then fundamental purpose of this work to emphasize all that coming from conventional context in the field of use of already known nondestructive techniques.

40720 (PNL-SA–16946) **Performance of a broadbanded ultrasonic transducer iwth coaxially mounted, nondirectional receiver.** Posakony, G.J.; Green, E.R. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890770–1: Conference on review of progress in quantitative NDE, Brunswick, ME (USA), 23-28 Jul 1989). Order Number DE89015838/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

For a majority of ultrasonic nondestructive testing application, the ultrasonic transducer used for transmission is also used for reception. When separate transducers are used, the receiving element is usually a duplicate of the transmitting element. In this situation, the directivity pattern of the transducer(s) is the same for transmission and reception. It is well established that the amount of energy and the directivity patterns reflected from a target (flaw or defect) are highly dependent on the type and shape of the target. Further, it is known that the directivity pattern of the receiving transducer can inhibit the ability to characterize the target. To study these effects, an experiment was designed using a nondirectional receiver, coaxially-mounted into the transmitting element. The objective was to demonstrate the influence of directionality as it relates to target orientation and size. 4 refs., 4 figs.

40721 (SAND–88-3362) **Structural code benchmarking data report.** Glass, R.E. Sandia National Labs., Albuquerque, NM (USA). May 1989. 26p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (TTC–0892). Order Number DE89014350/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A series of four impact tests has been performed at Sandia National Laboratories to provide data for the benchmarking of structural codes used to predict the response of packages to the regulatory 30-foot free drop event. A previous comparison of codes based on a standard problem set demonstrated that within the elastic response regime, there was good agreement between the codes and with closed form analytical solutions. Between codes and among differing users of the same code, greater variation occurred in predicting inelastic response. This led to the need for a standard problem based on experimental data which could be used as a benchmark for codes and users. This report provides the experimental data and establishes a standard problem based on the analysis of that data. 6 refs., 11 figs., 7 tabs.

40722 (SAND–89-0778) **Fatigue crack growth automated testing method.** Hatch, P.W.; VanDenAvyle, J.A.; Laing, J. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 45p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014352/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A computer controlled servo-hydraulic mechanical test system has been configured to conduct automated fatigue crack growth testing. This provides two major benefits: it allows continuous cycling of specimens without operator attention over evenings and weekends; and complex load histories, including random loading and spectrum loading, can be applied to the specimens to simulate cyclic loading of engineering structures. The software is written in MTS Multi-User Basic to control test machine output and acquire data at predetermined intervals. Compact tension specimens are cycled according to ASTM specification E647-86. Fatigue crack growth is measured via specimen compliance during the test using a compliance/crack length calibration determined earlier by visual crack length measurements. This setup was used to measure crack growth rates in 6063 aluminum alloy for a variety of cyclic loadings, including spectrum loads. Data collected compared well with tests run manually. 13 figs.

40723 (STEV-VIND–89-11) **Effect of residual stresses in the region of welds on crack propagation during fatigue loading.** Bogren, J. Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). Oct 1988. 39p. (In Swedish). (FFA-TN–1988-53). Order Number DE89902465/JAW. Available from NTIS (US Sales Only), PC A03.

The effect of residual stresses in the region of welds on crack propagation during fatigue loading is described. Both experiments and numerical calculations have been studied. Two different test pins have been used. Experiments show good consistency with literature data. Residual stress has been measured by means of X-ray diffraction. It is concluded that the shape of residual stress is not maintained on division, particularly on considerable reduction of

dimensions. The mathematical model predicts the behaviour of the crack propagation in a field of residual stresses rather well.

4208 Electronic Circuits and Devices

Refer also to citation(s) 40174, 40196, 40504, 40563, 40564

40724 (SAND–88-3442C) **Electrical measurements for CMOS IC stuck-open faults.** Soden, J.M.; Treece, R.K.; Taylor, M.R.; Hawkins, C.F. Sandia National Labs., Albuquerque, NM (USA). 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890846–1: International test conference, Washington, DC (USA), 29-31 Aug 1989). Order Number DE89005924/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two incidences of IC failure due to the CMOS stuck-open fault are reported here. The voltage levels, quiescent power supply current (I_{DDQ}), transient response, and tester properties associated with these defects are reported. The transient response of the defective node voltage and power supply current to the high impedance state caused by these defects was measured to determine if the I_{DDQ} measurement technique could detect stuck-open faults. The results show that the I_{DDQ} technique does detect stuck-open faults in some designs, but detection is not guaranteed for all circuits. Modifications to the circuit layout to reduce the probability of the stuck-open fault occurrence are presented. 22 refs., 7 figs.

40725 (SAND–89-0660) **Characterization of dc magnetron sputtering systems for the deposition of tantalum nitride, titanium, and palladium thin films for HMC [hybrid microcircuit] applications.** Snow, G.S. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 77p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014328/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report covers the initial characterization of two new dc magnetron sputtering systems which were acquired for the purpose of modernizing our capability for the deposition of tantalum nitride, titanium, and palladium thin films for HMC applications. These systems were purchased to replace two old metallization systems which had been used in this application for more than a decade. Parametric studies were carried out to characterize the systems. Operating conditions were established for the deposition of tantalum nitride films in one system and for the deposition of Ti/Pd films in the other system. These conditions were shown to produce films with properties equal to or better than were being achieved with the equipment being replaced. In addition, the new equipment was found to be simpler and easier to operate than the old systems. The data obtained during the course of this characterization study are presented. 15 refs., 44 figs., 8 tabs.

40726 (UCRL–100355) **Analysis of the performance of gallium arsenide photoavalanche switches.** White, W.T. III; Dease, C.G.; Khanaka, G.H. Lawrence Livermore National Lab., CA (USA). Jul 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890665–42: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89015774/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This work investigates how the dielectric relaxation that occurs after optical absorption can raise the electrical field from below avalanche threshold to above threshold inside a simple GaAs photoconductor. The process of optically raising the electrical field above its initial value we call "dynamic field enhancement." Tradeoffs between optical intensity, doping, optical absorption depth, and sample thickness are discussed with respect to obtaining useful performance of a dynamically field enhanced photoavalanche switch. We trace the origin of various contributions to field enhancement and deduce certain bounds on the magnitude of the process. In this work, response time is not considered. From a one-dimensional analysis, we conclude that, in homogeneous photoconductors with ohmic contacts, dynamic field enhancement is limited at low fields to roughly a factor of two increase. We compare our analysis to one- and two-dimensional calculations obtained with computer codes based on a drift/diffusion model. 5 refs., 6 figs., 1 tab.

40727 **Intrinsic noise in a Rb laser-excited optical filter.** Apel, E.C. (Los Alamos National Lab., Los Alamos, NM (US)); Gosnell, T.R.; Shay, T.M.; Samadani, R. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

Narrow-bandwidth optical sources are readily available. However, tunable narrow-bandwidth wide field-of-view optical filters are not available. The laser-excited optical filters (LEOFs) presented here are in principle tunable narrow-bandwidth wide field-of-view optical filters. These filters can simultaneously provide high-resolution (0.001-nm), wide field-of-view ($\pm 90^0$), high-quantum-efficiency, and electrically tunable optical filtering. These devices are ideally suited for extracting weak narrow-bandwidth signals buried in strong nonresonant optical background radiation. Potential applications of these filters include laser communications, laser radar, detection of Raman radiation, and atomic spectroscopy. These filters are atomic resonance filters which utilize photon absorption from the first excited state of an atom up to a higher lying level. A narrow-bandwidth laser is used to pump the necessary population into the atom's first excited state. The filtering process is initiated by photon absorption from the first excited state of the atom to a higher lying level. Subsequent radiative cascade from the upper level of the absorbing transition results in the emission of blue-shifted photons proportional to the number of absorbed photons.

4209 Waste Processing Plants and Equipment

Refer also to citation(s) 39911, 40028, 40040

4210 Combustion Systems

Refer also to citation(s) 39871, 39904, 40427, 40432, 40712

40728 (DOE/CE/90213–T4) **Aerodynamic effects on fuel spray characteristics: Air-assist atomizer.** Presser, C.; Semerjian, H.G.; Gupta, A.K. National Bureau of Standards, Washington, DC (USA). Center for Chemical Engineering. Jan 1988. 29p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-86CE90213. (CONF-880802–11: 22. international symposium on combustion, Seattle, WA (USA), 14-19 Aug 1988). Order Number DE89015819/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results are presented on the internal structure of a kerosene fuel spray, generated with an air-assist type nozzle. Effects of atomization air flow rate and combustion air swirl on droplet transport processes have been investigated. Spatially-resolved measurements have been obtained on mean droplet size, number density and velocity, at different combustion air swirl and atomization air flow rates. An ensemble light scattering technique, based on measurement of the polarization ratio, and laser velocimetry have been used for these measurements. The results indicate that as atomization air flow rate increases, the spray becomes confined to a narrower spray angle; in addition, mean droplet size decreases and number density increases significantly along the spray centerline. Larger droplets are found generally on the spray boundary, and smaller ones near the spray centerline. In all cases, there is a gradual increase in mean droplet size along the spray centerline with axial distance. Under burning conditions the flame plume becomes short and intense, with fewer droplets penetrating through the flame envelope. Combustion air swirl and atomization air have a significant effect on the transport of droplets and on combustion characteristics of spray flames. 20 refs., 9 figs.

40729 (STEV-FBT–89-22) **Signature of the flame Lightech AB. Final report.** Dahlander, P. Statens Energiverk, Stockholm (Sweden). Jan 1988. 26p. (In Swedish). Order Number DE89902420/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The method of controlling combustion is based on optical observation of the flame. A sooting flame emits yellow/red colors and a non-sooting flame will emit blue/green colors. This can be used to regulate the fuel/air ratio of combustion. When placing the fiber optics window in a sheltered way good emittance from the combustion

zone can be obtained. The optical fibers are placed centrally on the burner nozzle and cooled by the fuel. Measurements show the relation between the spectra of the flame and the content of CO in flue gas as a function of the fuel/air ratio. The conditions can be used in a microprocessor to govern stepping motors to regulate fuel pressure and the air damper. Standardized components have been used for the prototype which has functioned well. (G.B.).

4220 Underground Engineering

Refer also to citation(s) 40039, 40049

4230 Marine Engineering

Refer also to citation(s) 40158

40730 (MU/CCORE–1988) **Large scale iceberg impact tests. Site selection, hydraulic tests and other requirements. Study 8.** Duthinh, D. Memorial Univ. of Newfoundland, St. John's, NF (Canada). Centre for Cold Ocean Resources Engineering. 1988. 16p. (CONF-8807179–: Ice-structure interaction workshop, Calgary (Canada), 27 Jul 1988; MICROLOG–89-01551). Available from Centre for Cold Ocean Resources Engineering, C-CORE, Memorial University of Nfld., St. John's, NF, Canada A1B 3X5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Large scale sea ice impact tests have contributed significantly to ice engineering and the design of Beaufort Sea structures. No test of similar scale exists for icebergs. This report establishes that full scale iceberg impact experiments are feasible. Such experiments would be an important advance in ice mechanics and in the prediction of iceberg impact loads on offshore structures. The recommended site for the experiments is Deep Water Point, near St. Anthony, on the northern tip of Newfoundland. The site combines steep cliffs, deep waters, a relatively predictable iceberg population, and ease of access. The recommended experimental method is to tow an iceberg into the cliff with two tugboats. Tow ropes should be looped around on-shore pulleys installed on either side of the instrumented target. Model tests confirm that this arrangement provides the best control and reliability. 3 refs., 5 figs.

4250 Power Cycles

Refer also to citation(s) 40144

43 PARTICLE ACCELERATORS

40731 (CERN–89-04) **CAS CERN Accelerator School superconductivity in particle accelerators. Proceedings.** Turner, S. (ed.). European Organization for Nuclear Research, Geneva (Switzerland). 10 Mar 1989. 331p. (CONF-8805305–: CAS course on superconductivity in particle accelerators, Hamburg (Germany, F.R.), 30 May - 3 jun 1988). Order Number DE89620100/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

One of the objectives of the CERN Accelerator School is to run courses on specialised topics in the particle accelerator field. The present volume contains the proceedings of one such course, this time organized in conjunction with the Deutsches Elektronen Synchrotron (DESY) on the subject of superconductivity in particle accelerators. This course reflects the very considerable progress made over the last few years in the use of the technology for the magnet and radio-frequency systems of many large and small accelerators already in use or nearing completion, while also taking account of the development work now going on for future machines. The lectures cover the theory of superconductivity, cryogenics and accelerator magnets and cavities, while the seminars include superfluidity, superconductors, special magnets and the prospects for high-temperature superconductors.

40732 (CERN–89-05) **CAS CERN Accelerator School third general accelerator physics course. Proceedings.** Turner, S. (ed.). European Organization for Nuclear Research, Geneva (Switzerland). 20 Apr 1989. 253p. (CONF-8809376–: CAS CERN Accelerator School: 3. general accelerator physics course, Salamanca (Spain), 19-30 Sep 1988). Order Number DE89633417/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The general course on accelerator physics given in Salamanca, Spain, closely followed those organised by the CERN Accelerator School at Gif-sur-Yvette, Paris in 1984, and at Aarhus, Denmark in 1986 and whose proceedings were published as CERN Yellow Reports 85-19 (1985) and 87-10 (1987) respectively. However, certain topics were treated in a different way, improved or extended, while some new ones were introduced and it is all of these which are included in the present proceedings. The lectures include beam-cooling concepts, Liouville's theorem and emittance, emittance dilution in transfer lines, weak-betatron coupling, diagnostics, while the seminars are on positron and electron sources, linac structures and the LEP L3 experiment, together with industrial aspects of particle accelerators. Also included are errata and addenda to the Yellow Reports mentioned above. (orig.).

4301 Design, Development, and Operation

Refer also to citation(s) 40744, 40776, 41069, 41130

40733 (BNL–42834) **A review on the lattice design of large hadron colliders.** Lee, S.Y. Brookhaven National Lab., Upton, NY (USA). 1987. 46p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8707208–7: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987). Order Number DE89014040/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The conceptual evolution of the accelerator lattice design is discussed. Indicated are aspects of IR design. We emphasize the cancellation of stop-band width in the cluster design. The case of symmetric vs antisymmetric design is also discussed. The SSC lattice is used as an example. 9 refs.

40734 (CRN-VIV–55/1) **Contributions of the Vivitron group to the following conference: European Particle Accelerator Conference, Rome, June 1988.** Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Jun 1988. 7p. (CONF-880695–: 1. European Particle Accelerator Conference (EPAC-1), Rome (Italy), 7-11 Jun 1988). Order Number DE89903297/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Two papers of the European particle accelerator conference, June 1988, Rome.

40735 (CRN-VIV–55/1, pp. 1-4) **Brief review of the development of electrostatic accelerators and continuing work at Strasbourg.** Letournel, M. (Strasbourg - 1 Univ., 67 (FR). Centre de Recherches Nucleaires). Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Jun 1988. (CONF-880695–: 1. European Particle Accelerator Conference (EPAC-1), Rome (Italy), 7-11 Jun 1988). In *Contributions of the Vivitron group to the following conference: European particle accelerator conference, Rome, June 1988.* Order Number DE89903297/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The development of electrostatic accelerators follows the need of high energy charged particles. It has been a continuous increase in voltage from some MV in the 1930's, up to some 20 MV nowadays, and around 35 MV in a near future. That allows to accelerate and to make nuclear reactions for almost all stable nuclei existing in nature.

40736 (CRN-VIV–55/1, pp. 5-7) **Strasbourg project. A 35 MV Vivitron tandem.** Letournel, M. (Strasbourg - 1 Univ., 67 (FR). Centre de Recherches Nucleaires). Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Jun 1988. (CONF-880695–: 1. European Particle Accelerator Conference (EPAC-1), Rome (Italy), 7-11 Jun 1988). In *Contributions of the Vivitron group to the following conference: European particle accelerator conference, Rome, June 1988.* Order Number DE89903297/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The 35 MV Van de Graaff Tandem Accelerator called Vivitron is under construction. Voltage tests are expected in 1989 and final completion in 1990. At the last international accelerator conference in Washington we reported the start of the construction of the Vivitron, a new 35 MV Tandem Van de Graaff. All decisions about the

design have now been taken. The construction itself progresses straightforwardly. The voltage tests should be made in 1989, the machine will be completed and ready in 1990.

40737 (FNAL-TM–1598) **High intensity hadron accelerators.** Teng, L.C. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890299–15: AHF accelerator design workshop, Los Alamos, NM (USA), 20-25 Feb 1989). Order Number DE89014356/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This rapporteur report consists mainly of two parts. Part I is an abridged review of the status of all High Intensity Hadron Accelerator projects in the world in semi-tabulated form for quick reference and comparison. Part II is a brief discussion of the salient features of the different technologies involved. The discussion is based mainly on my personal experiences and opinions, tempered, I hope, by the discussions I participated in in the various parallel sessions of the workshop. In addition, appended at the end is my evaluation and expression of the merits of high intensity hadron accelerators as research facilities for nuclear and particle physics.

40738 (IKDA–88-14) **Darmstadt Linear Accelerator (DALINAC) Research Laboratory. Status report - July 1988.** Anon. Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik. Jul 1988. 22p. (CONF-880865–: Gordon conference on atomic and molecular interactions, Plymouth, NH (USA), 1-5 Aug 1988). Order Number DE89794773/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

The status of the DALINAC project is reviewed. The accelerator and the experimental facilities are described, and a free-electron laser project is considered. Furthermore, experiments on inelastic electron scattering on nuclei and atomic systems are listed. (HSI).

40739 (ORNL/FTR–3327) **[Meeting between the NA35 and WA80 collaborations to complete a letter of intent proposing a joint experiment to be performed when lead beams become available at CERN, Frankfurt, W. Germany and Geneva, Switzerland, June 28–July 7, 1989]: Foreign trip report.** Young, G.R. Oak Ridge National Lab., TN (USA). 17 Jul 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015824/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in a meeting between the NA35 and WA80 collaborations for the purpose of completing a letter of intent to the CERN SPS Committee, setting out our plans for a joint proposal to use the lead beams that may be available in 1993 from the CERN SPS. The main thrusts of the joint proposal are large acceptance and particle identification for all charged particles in the forward hemisphere and precision detection of photons over a restricted range of rapidity. The principal elements of the experiment are a set of 5 TPCs and 4 RICH counters to accomplish the first objective and an array of 3000 BGO crystals to accomplish the second. The travelers then spent one week at CERN working with H.-A. Gustafsson of Lund University on a redesign and upgrading of the trigger for the WA80 experiment. The major changes proposed are full programmability of the trigger and installation of a trigger supervision system, including a digital oscilloscope and a high-bandwidth logic analyzer, to set up and monitor the WA80 trigger.

40740 (SLAC-PUB–4996) **Physics of a high luminosity collider operated near charm and tau pair thresholds.** Schindler, R.H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8904226–5: 12. international workshop on weak interactions and neutrinos, Ginosar (Israel), 9-14 Apr 1989). Order Number DE89013895/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The current plans for a high luminosity e^+e^- collider between 3.0 and 4.4 GeV/c^2 are described. Such a dedicated facility (The Tau-Charm Factory), operating near tau-pair and charm thresholds would allow studies of the decay of the third generation tau-lepton and the second generation c-quark with unprecedented precision and control of systematics. The charm physics of such a facility is discussed. 24 refs., 4 figs., 7 tabs.

40741 (SLAC-PUB–5010) **Status of the SLC [Stanford Linear Collider].** Coupal, D.P. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8903132–9: 24. Rencontres de Moriond: electroweak interactions and unified theories, Les Arcs (France), 5-12 Mar 1989). Order Number DE89013989/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report presents a brief review of the status of the Stanford Linear Collider. Topics covered are: Beam luminosity, Detectors and backgrounds; and Future prospects. 3 refs., 8 figs., 1 tab. (LSP)

40742 (UCRL–99579) **Status of the ETA-II linear accelerator: High brightness results.** Turner, W.C.; Boyd, J.K.; Clark, J.C.; Nexsen, W.E. Lawrence Livermore National Lab., CA (USA). 1989. 16p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890335–240: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89016658/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A two-aperture collimator has been used to measure brightness of the electron beam produced by the injector and the first 20 acceleration cells of the ETA-II linear induction accelerator. Osmium alloy dispenser cathodes produce the electron beam. For accelerated currents up to 1.5 kA with 2.0 to 2.7 MeV beam energies the measured brightness is 4×10^9 A/(rad-m)^2, exceeding our design goal by a factor of 2. At the highest current, 2.0 kA, a beam brightness of 2.6×10^9 A/(rad-m)^2 has been measured. 6 refs., 5 figs.

40743 (UCRL–100322) **Timing and voltage control for magnetic modulators on ETA-II.** Newton, M.A.; Watson, J.A. Lawrence Livermore National Lab., CA (USA). 17 May 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890665–40: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89015772/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Experimental Test Accelerator II is a high-average-power, high-repetition-rate linear induction accelerator at Lawrence Livermore National Laboratory. Magnetic pulse compressors are used in the power conditioning chains that produce pulses used to accelerate the electron beam. Stable operation of each power-conditioning chain is essential to overall accelerator performance. Variations in voltage or timing ("jitter") of pulses driving the induction cells can cause unacceptable variation in electron-beam energy. This paper reviews techniques developed and implemented to regulate voltage and to control sources of timing jitter. These techniques have demonstrated subnanosecond jitter and ±0.1% pulse-to-pulse voltage regulation of the accelerator drive pulses. 7 figs.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 40759, 41056, 41060, 41215

40744 (BNL–42937) **The attainment of large accelerating gradients using near field synchrotron radiation.** Decker, G. Brookhaven National Lab., Upton, NY (USA). 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890197–11: Advanced accelerator concepts workshop, Lake Arrowhead, CA (USA), 9-13 Jan 1989). Order Number DE89015075/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Lienard-Wiechert potentials are used to find the electromagnetic field everywhere in free space resulting from a point charge moving on a helical trajectory. The total power emitted as synchrotron radiation from a particle on a circular path is calculated. The point charge results are generalized to the case of a line charge, and formulae are presented which can easily be evaluated numerically. A useful gradient of 80 MeV/m per kA of peak driving beam current over a distance of 1 cm is calculated using two 5 MeV driving beams moving on 1 cm radius helical orbits with bunch length 1 mm. 11 refs., 5 figs.

40745 (BNL–42939) **Beam transfer function and Landau damping.** Wang, J.M. Brookhaven National Lab., Upton, NY (USA).

May 1989. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8810356–3: 3. joint US-Cern accelerator school on particle accelerators: frontiers of particle beams, observations, diagnosis, and correction, Capri (Italy), 20-26 Oct 1988). Order Number DE89015111/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: beam polarization; beam transfer function; weak Landau damping limit; and Landau damping and resonant energy exchange.

40746 (FNAL/C–89/87) **Stimulated longitudinal emittance growth in the Main Ring.** Jackson, G.; Ieiri, T. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890335–234: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89015141/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

During fixed target operations – beam intensity is limited by coherent instabilities in both the Main Ring and Tevatron. The growth rates for instabilities are generally inversely proportional to the proton bunch length. Since fixed target operations are insensitive to the longitudinal emittance of the beams, bunch spreaders are employed to increase the emittance, and hence the bunch length. Emittance growth is stimulated by injecting noise onto either the RF phase or amplitude control voltages. Test results of the efficiency of various stimulation schemes are reported. The design of a bunch length monitor, used to measure the effect of the bunch spreader, is also presented. 12 refs., 5 figs.

40747 (FNAL-TM–1599) **Fermilab fixed target beams from the main injector.** Childress, S.; Coleman, R.; Koizumi, G.; Malensek, A.; Moore, C.; Schailey, R.; Stefanski, R.; Stutte, L. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 60p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8905183–3: Workshop on physics at the main injector, Batavia, IL (USA), 16-18 May 1989). Order Number DE89014355/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics at Fermilab: 120–150 GeV beam extraction; link to switchyard; primary beam splits and transport; and experimental facilities at 120–150 GeV.

40748 (INFN-LNF–89-002(R)) **Tagged photon beam polarization of the jet target experiment. A feasibility study.** Bianchi, N.; Muccifora, V. Istituto Nazionale di Fisica Nucleare, Rome (Italy). 1989. 15p. (In Italian). Order Number DE89633420/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The applicability of the residual electron selection method to the tagging method of the jet target laboratory has been studied. With this end in view the behaviour of the polarized bremsstrahlung cross section in the range considered has been analysed, while the polarization increase by means of the RES has been evaluated. The vertical conditions of the focusing of the tagging spectrometer as a function of energy have been determined. Finally the gamma beam density and the tagging efficiency have been calculated.

40749 (LA-UR–89-2140) **Higher-order mode suppression for the AHF main ring cavity.** Walling, L.; Thiessen, A.; McMurry, D. Los Alamos National Lab., NM (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8903144–1: Advanced hadron workshop, Los Alamos, NM (USA), Mar 1989). Order Number DE89014293/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

At Los Alamos National Laboratory, we are studying higher-order-mode (HOM) suppression schemes for the ferrite-tuned main ring cavity of the Advanced Hadron Facility (AHF). We have built a simplified half-scale model of the cavity which is a $\lambda/4$ coaxial cavity. The accelerating mode frequency is 107 MHz. This model has a shorted line that replaces the ferrite-loaded tuning leg and a sliding-short line that replaces the drive leg. The quality factor (Q) and shunt impedance ($R = V^2/P$), where V is the voltage at the gap and P is the power dissipated in the cavity, of the first 10 or so modes of the cavity were measured. Beadpulls were performed to map out some of the electric and magnetic field patterns. It is interesting to note that there are two modes that represent each $n\lambda/4$ TEM mode field pattern: one mode has field in both the main cavity and in the side cavity, and one has field only in the main cavity section. We wish to use the first mode with field in both the main and side cavity in order to tune the cavity using ferrites. We have attempted HOM damping using several methods. 1 ref., 8 figs., 1 tab.

40750 (SLAC-PUB–4886) **Beam dynamics issues in linear colliders.** Seeman, J.T. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890335–222: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89013890/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The primary goal of present and future linear colliders is to maximize the integrated luminosity for the experimental program. Beam dynamics plays a central role in the maximization of integrated luminosity. It is the major issue in the production of small beam sizes and low experimental backgrounds and is also an important factor in the production of particle numbers, in the acceleration process, and in the number of bunches. The beam dynamics effects on bunches which are extracted from the damping rings, accelerated in the linac, collimated, momentum analyzed, and finally delivered to the final focus are reviewed. The effects of bunch compression, transverse and longitudinal wakefields, BNS damping, energy definition, dispersion, emittance, bunch aspect ratio, feedback, and stability are all important. 11 refs., 1 tab.

40751 (SLAC-PUB–5011) **Crab-crossing in a Tau-Charm facility.** Voss, G.A.; Paterson, J.M.; Kheifets, S.A. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–4: Tau-Charm workshop, Stanford, CA (USA), 23-27 May 1989). Order Number DE89013988/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report discusses the following topics: crab-crossing; horizontal versus vertical beam crossing; a crab-crossing arrangement for a Tau-Charm facility; tolerance; and beam loading and average current limitations. 7 refs., 1 fig., 1 tab. (LSP)

40752 (SLAC-PUB–5020) **Bounds on nonlinear motion for a finite time.** Warnock, R.L.; Ruth, R.D. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890594–2: 3. advanced inertial confinement fusion accelerator beam dynamics workshop: beam-beam effects in circular colliders, Novosibirsk (USSR), 20 May - 3 jun 1989). Order Number DE89014396/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent improvements in numerical methods to compute canonical transformations make it feasible to set interesting bounds on the motion of nonlinear Hamiltonian systems over a finite interval of time. 7 refs.

40753 (UCRL–100321) **Fast correction coils for induction accelerators.** Whitham, K.; Caporaso, G.; Thomas, R.; Vogtlin, G.; Zentler, J.; Coffield, F.; Bowles, E. Lawrence Livermore National Lab., CA (USA). 17 May 1989. 6p. Sponsored by DOD;DOE/DP. DOE Contract W-7405-ENG-48. (CONF-890665–37: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89015769/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In order to correct transverse beam motion during a 50 ns duration beam pulse, a set of coils has been designed with drive power in the 3 MW range to operate at a bandwidth of 50 MHz. A description of the pulser and a particular application is given along with pertinent test data. 2 refs., 8 figs., 2 tabs.

40754 (UCRL–100363) **An experiment on electron beam transport in an array of wires.** Richardson, R.A.; Denavit, J.; Rambo, P.W. Lawrence Livermore National Lab., CA (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890665–35: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89015049/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have investigated experimentally the propagation of relativistic electron beam through an array of parallel conducting wires. Theory and particle simulation predict such an array will provide both charge and current neutralization, allowing beam transport above the drift tube limit. We injected a 60 ns, 17kA (120 A/cm^2) pulse of 1.4 MeV electrons into an array of 1 m long wires spaced 1 cm apart, filling a hexagon 15 cm across. Arrays have been tested with 12 mil diameter copper wire, 3 mil stainless steel wire, and 12 mil copper wires terminating on an insulated, segmented beam dump. Ḃ probes and streak camera data show that 67% of the current is transported in the case of the stainless steel array. The copper wire array transported electrons for 20 ns only. The beam is injected with a 250 mrad divergence, and the transported beam has a divergence of less than 100 mrad. Follow-up experiments are to use thinner wires to improve the propagation and divergence of the beam. 3 refs., 9 figs., 1 tab.

4303 Auxiliaries and Components

Refer also to citation(s) 40586, 40747, 40753, 41057, 41072

40755 (BNL–42044) **Electrical measurements during magnet construction.** Sintchak, G.; Ganetis, G.; Cottingham, G. Brookhaven National Lab., Upton, NY (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890270–21: International industrial symposium on the super collider, New Orleans, LA (USA), 8-10 Feb 1989). Order Number DE89015110/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Throughout the construction phase of the cold mass for SSC magnets, electrical tests are made to determine that no faults in the coil structure have developed. These tests include ones designed to measure turn-to-turn voltage hold-off, hypot tests to ground, coil resistance, and instrumentation checks. These various tests will be described and the test parameters that are used will be covered. 4 figs.

40756 (CONF-890618–3) **A laser-driven source of polarized hydrogen and deuterium.** Young, L.; Holt, R.J.; Gilman, R.A.; Kowalczyk, R.; Coulter, K. Argonne National Lab., IL (USA). 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From NICOLS '89: 9th international conference on laser spectroscopy; Bretton Woods, NH (USA); 18-23 Jun 1989. Order Number DE89015130/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A novel laser-driven polarized source of hydrogen and deuterium which operates on the principle of spin-exchange optical pumping is being developed. This source is designed to operate as an internal target in an electron storage ring for fundamental studies of spin-dependent structure of nuclei. It has the potential to exceed the flux from existing conventional sources (3×10^{16}/s) by an order of magnitude. Currently, the source delivers hydrogen at a flux of 8×10^{16} atoms/s with an atomic polarization of 24% and deuterium at 6×10^{16} atoms/s with a polarization of 29%. Technical obstacles which have been overcome, with varying degrees of success are complete Doppler-coverage in the optical-pumping stage without the use of a buffer gas, wall-induced depolarization and radiation-trapping. Future improvements should allow achievement of the design goals of 4×10^{17} atoms/s with a polarization of 50%. 8 refs., 2 figs.

40757 (CONF-890703–13) **Beam dynamics of a liquid metal ion source.** Whealton, J.H.; Meszaros, P.S.; Rothe, K.E.; Raridon, R.J.; Ryan, P.M. Oak Ridge National Lab., TN (USA). 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on ion sources; Berkeley, CA (USA); 9-15 Jul 1989. Order Number DE89015856/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

RMS emittance growth of liquid metal ion sources is studied. Processes included are nonlinear expansion through extractor and accelerator fringe fields, nonlinear beam space charge, plasma effects near needle, and waves (either ion-acoustic or space charge limited as considered by V.I. Dudnikov). This investigation consists of 2-D analysis of appropriate Vlasov-Poisson equations in both steady-state and time-dependent formulations. Various geometries will be considered such as some used by G. Alton of ORNL. 2 refs., 7 figs.

40758 (CRN-VIV–59) **Gas transfer system.** Oberlin, J.C.; Frick, G.; Kempfer, C.; North, C. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Sep 1988. 8p. (In French). Order Number DE89903300/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The state of work on the Vivitron gas transfer system and the system functions are summarized. The system has to: evacuate the Vivitron reservoir; transfer gas from storage tanks to the Vivitron; recirculate gas during operation; transfer gas from the Vivitron to storage tanks; and assure air input. The system is now being installed. Leak alarms are given by SF6 detectors, which set off a system of forced ventilation. Another system continuously monitors the amount of SF6 in the tanks.

40759 (FNAL/C–89/92) **A new high-gradient correction quadrupole for the Fermilab luminosity upgrade.** Mantsch, P.; Carson, J.; Riddiford, A.; Lamm, M.J. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890335–235: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89015142/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Special superconducting correction quadrupoles are needed for the luminosity upgrade of the Fermilab Tevatron Collider. These correctors are part of the low-beta system for the interaction regions at Bϕ and Dϕ. The requirements are high gradient and low current. A quadrupole has been designed that meets the operating gradient of 0.63 T/cm at 1086 A. The one-layer quadrupole is wound with a cable consisting of five individually insulated rectangular strands. The five strands are overwrapped with Kapton and epoxy impregnated glass tape. The winding, curing and collaring of the magnet is accomplished in the same manner as Tevatron-like magnets using Rutherford style cable. Once the magnet is complete the five strands are connected in series. A prototype quadrupole has been assembled and tested. The magnet reached a plateau current of 1560 A corresponding to a gradient of 0.91 T/cm without training. The measured field harmonics are substantially better than required. 8 refs., 6 figs., 4 tabs.

40760 (FNAL-TM–963) **Design for a new wide-band neutral beam for the tevatron.** Butler, J.; Cumalat, J.P.; Garbincius, P.H.; Hawkins, J.; Stanfield, K.C. Fermi National Accelerator Lab., Batavia, IL (USA). 25 Apr 1989. 64p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89014358/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Fermilab's two photon beams, the tagged beam and the broad-band beam, do not run simultaneously because they must share the same primary proton beam and some beam enclosures. We demonstrate that the present broad-band beam is inadequate for operation at 1 TeV and propose to replace it with a versatile Wide Band Charged and Neutral beam. We discuss the necessary improvements to Proton East primary beam transport systems, the new beam optics and acceptances, the targeting scheme, expected fluxes, backgrounds from muons, and unwanted hadrons in the beam, the radiator and dump areas, the required experimental hall and its facilities, and a possible time table. 20 refs., 20 figs., 6 tabs.

40761 (FNAL-TM–1577) **Single bunch intensity monitoring system using an improved wall current monitor.** Moore, C.D.; Crisp, J.; Howard, D.; Kerns, Q.; Martin, P.; McConnell, D.; Michals, P.; Payne, J.; Tawzer, S.; Webber, R. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890335–236: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89014360/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Important parameters in collider operations are the length and intensity of individual beam bunches. A system to automatically measure these parameters has been developed using a wall current monitor signal digitized by a 1 GHz sampling oscilloscope under microprocessor control. Bunch length and intensity are computed by the microprocessor and presented to the host computer. To verify

the required accuracy, attention has been paid to the calibration and frequency response of the system. Design and performance of a new wall current monitor with improved bandwidth is presented. 4 refs., 3 figs.

40762 (GANIL-A–89-02) **Medium energy beam facility at Ganil.** Beck, A.R. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1989. 4p. (CONF-890560–: 12. international conference on cyclotrons and their applications, Berlin (Germany, F.R.), 8-12 May 1989). Order Number DE89903235/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

By the end of 1989 a medium energy ion beam facility, called S.M.E. (Sortie Moyenne Energie) will be operational at GANIL. It will be dedicated mainly to investigations in non-nuclear physics. This new facility will use ions that do not have after stripping the right charge state to be accelerated in the last cyclotron stage. Ions from carbon to uranium will be available in an energy range from 15 down to 5 MeV/u, with a beam emittance of 10 Pimm mrd.

40763 (GANIL-A–89-03) **Preliminary design of a new high intensity injection system for Ganil.** Ricaud, C.; Attal, P.; Baron, E.; Beck, R.; Bony, J.; Bourgarel, M.P.; Bru, B.; Chabert, A.; Chel, S.; Vienet, R. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1989. 4p. (CONF-890560–: 12. international conference on cyclotrons and their applications, Berlin (Germany, F.R.), 8-12 May 1989). Order Number DE89903234/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In order to increase the beam intensities delivered by the GANIL injectors, which are presently limited either by space charge effects (light ions) or by low source currents (heavy ions), we are designing a new high efficiency injection system. A new beam line has been designed for an optimal matching of the beam in the six-dimensional phase space between the ECR ion source installed on a 100 kV platform and the first accelerating gap of injector cyclotron C01. The beam dynamics computation takes into account the spiral inflector associated with a small electrostatic quadrupole located immediately after. The principle and the design of the new injection system, as well as the expected performances, are described in this paper. The completion of this system is planned for the end of 1990.

40764 (GANIL-A–89-06) **Modification of the Ganil injectors.** Bourgarel, M.P.; Baron, E.; Attal, P. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1989. 5p. (CONF-890560–: 12. international conference on cyclotrons and their applications, Berlin (Germany, F.R.), 8-12 May 1989). Order Number DE89903233/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

As part of the upgrading project of the GANIL accelerator complex, we have modified the two injector cyclotrons in order to increase their energy, which implies a larger extraction radius and a change of the harmonic mode operation from 4 to 3. The main consequence of this last point is to compel us to use a 180^0C dee and to double the number of turns (N=25) which leads to replace the flat poles by spiraled sector poles and to redesign the central and extraction regions with the new isochronous field topology. Beam orbit dynamics computation results are presented. The first injector is now coupled to the present axial injection beam line (23 kV) with a CAPRICE ECR source. The second cyclotron, nearly identical to the first one, will be connected to the future 100 kV axial injection line (described in this conference). This implies a new inflector and a new central region.

40765 (IFUSP-P–762) **USP pelletron-superconducting linac project in conjunction with ANL.** Sala, O.; Pessoa, E.F. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Dec 1988. 28p. Order Number DE89633442/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report is a synopsis of the present day technology involved in the use of superconducting radio frequency resonators as accelerating units for heavy ion beams and the plans for employing this technology in the new extension of the Sao Paulo Pelletron accelerator in a cooperative program with Argonne National Laboratory, USA. (author).

40766 (JINR-R–9-88-366) **About the requirements to the electron beam parameters and the compressor systems.** Aleksandrov, V.S.; Kazarinov, N.Yu.; Sarantsev, V.P.; Shirkov, G.D. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 8p. (In Russian). Order Number DE89633434/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The modification of the Heavy Ion Collective Accelerator compressing system is presented. This modification allows to form the electron-ion rings in the magnetic field with a field index values approximately equal to 0,5 for a wide radius range. The requirements of both electron rings formed on the initial orbit and magnetic field system are found. 11 refs.; 8 figs.

40767 (JINR-R–9-88-423) **Electron-ion ring forming in the KUTI-20 adhezator magnetic system with increased field index value.** Aleksandrov, V.S.; Aleksakhin, Yu.I.; Antropov, V.K. and others. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 6p. (In Russian). Order Number DE89633435/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The results of modernization of KUTI-20 adhezator magnetic system for the electron-ion compression in magnetic field with field index value approximately equal 0,5 are presented. This variant of the magnetic system operation regime allowed one to increase the electron number in the initial radius, on crossing the betatron oscillation resonances and compressed electron ring parameters are given. 10 refs.; 6 figs.; 1 tab.

40768 (KEK–88-7, pp. 46-52) **Production of negative ions by using a sputter ion source and the measurement of atomic and molecular ion transmission in a tandem accelerator.** Shima, K. (Tsukuba Univ., Ibaraki (Japan). Tandem Accelerator Center); Takahashi, T.; Kakita, T.; Yamanouchi, M. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba (Japan), 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Negative ions have been produced by using a sputter ion source for about 70 kinds of elements. About 40 kinds of them were in the form of molecules because of the single atomic electron affinity being low or negative. Transmission of accelerated ions has been measured for the injection of atomic and molecular ions in a 12 MV tandem accelerator. Result of the transmission has been analyzed based on the coulomb explosion of a molecule occurred at the moment of collision with a charge stripper.

40769 (SAND–89-0716) **Results of atomic Xe laser operation at high energy loadings.** Patterson, E.L.; Samlin, G.E.; Brannon, P.J. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 35p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE89014337/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Preliminary atomic Xe laser results are presented for e-beam excitation at pump rates between 40 W/cm^3 and 1 kW/cm^3 and for pump times between 50 μs and 1 ms. 44 refs., 15 figs., 2 tabs.

40770 (SLAC-PUB–4858) **High speed switching in gases.** Cassell, R.E.; Villa, F. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Feb 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8810135–6: Switched-power workshop; 4. workshop on pulse power techniques for future accelerators, Shelter Island, NY (USA), 16-21 Oct 1988; 4-9 mar 1989; CONF-8903146–1). Order Number DE89014394/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A fast, efficient and reliable switch is the basic ingredient of a pulse power accelerator. Two switches have been proposed so far: the solid state switch, and the vacuum photodiode switch. The solid state version has been tested to some extent, albeit at low (few kilovolts) level, with risetime around 10 ps in the radial line transformer configuration. The vacuum photodiode is being investigated by Fisher and Rao at Brookhaven National Laboratory. Common to both switches is the need of a short laser pulse; near infrared for the solid state switch, and ultraviolet for the vacuum photodiode switch. Another common feature is the poor energy gain of these switches: the gain being the ratio between the electrical energy

switched and the laser energy needed to drive the switch. For the solid state switch, calculations and experimental data show that the energy gain cannot exceed a value between 5 and 10. For the vacuum photodiode, the situation is somewhat similar, unless very high quantum efficiency, rugged photocathodes can be found. A closing switch also can be used to produce short pulses of rf at frequencies related to its closing time, using a well-known device called the frozen wave generator. For a risetime of the order of 30 ps, one could produce several Gigawatts of rf at Xband at very low cost. 12 refs., 12 figs.

40771 (UCRL–100317) **Modeling the characteristics of a magnetically switched pulse forming line.** Barrett, D.M. Lawrence Livermore National Lab., CA (USA). 17 May 1989. 6p. Sponsored by DOD;DOE/DP. DOE Contract W-7405-ENG-48. (CONF-890665–39: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89015771/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent developments in magnetic switching technology have enabled linear induction accelerators to operate at high repetition rates. These accelerators provide high-average-power electron beams for many applications. However, some applications, such a free-electron lasers, also require a beam with a very narrow energy spread. As a result, the characteristics of the waveform driving the induction cell are very critical. Several accelerator systems at Lawrence Livermore National Laboratory use three-stage magnetic pulse compressors in which the final stage consists of a pulse-forming line (PFL) followed by a saturable output reactor. Ideally, the PFL forms a pulse with the required rise time and flatness. Unfortunately, traveling waves introduced on the PFL during the charging process as well as output switch performance may degrade the pulse shape. To understand the effect of these factors upon the output pulse shape, we have used the computer code SPICE to model the final stage. The model simulates PFL dynamics under various conditions and includes a first-order model of the saturable output reactor. Discussed in this paper are the saturable inductor model and results obtained with the final stage compression model. 10 refs., 11 figs., 1 tab.

40772 (UCRL–100320) **A battery-powered, solid state magnetic compressor with applications for high PRF accelerators and lasers.** Bowles, E.E.; Burley, B.L.; Barrett, D.M.; Kirbie, H.C.; Newton, M.A. Lawrence Livermore National Lab., CA (USA). 17 May 1989. 6p. Sponsored by DOD;DOE/DP. DOE Contract W-7405-ENG-48. (CONF-890665–38: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89015770/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An 8-J/pulse magnetic pulse compressor has been built to demonstrate a power conditioning technique whereby battery power is converted into a train of 5-μs pulses at a maximum pulse repetition frequency of 11 kHz. The machine employs inverter-grade thyristors that switch with less than 120-ps pulse-to-pulse jitter. The network uses a phased-triggering scheme to obtain an output voltage regulation of $\pm$0.002%. Magnetic core reset is achieved by using a reflected portion of the output pulse from a mismatched load. 3 refs., 6 figs., 2 tabs.

4304 Storage Rings

Refer also to citation(s) 41062, 41115, 41120, 41126

40773 (BNL–42010) **Experience with Phase II insertion devices in the x-ray ring.** Decker, G.; Galayda, J.; Krinsky, S.; Solomon, L. Brookhaven National Lab., Upton, NY (USA). 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–232: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89015105/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The installation of Phase II insertion devices in the NSLS x-ray ring was completed in February 1989, when the hybrid wiggler magnet (HBW) for beam line X21 and the superconducting wiggler (SCW) for beam line X17 were installed. Prior to this time, the soft x-ray undulator (SXU) and X1, another hybrid wiggler at X25, and the ten period mini-undulator at X13 had been installed. 8 refs., 4 figs., 2 tabs.

40774 (BNL–42011) **Orbit stability and feedback control in synchrotron radiation rings.** Yu, L.H. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–233: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89015103/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Stability of the electron orbit is essential for the utilization of a low emittance storage ring as a high brightness radiation source. We discuss the development of the measurement and feedback control of the closed orbit, with emphasis on the activities as the National Synchrotron Light Source of BNL. We discuss the performance of the beam position detectors in use and under development: the PUE rf detector, split ion chamber detector, photo-emission detector, solid state detector, and the graphite detector. Depending on the specific experiments, different beamlines require different tolerances on the orbit motion. Corresponding to these different requirements, we discuss two approaches to closed orbit feedback: the global and local feedback systems. Then we describe a new scheme for the real time global feedback by implementing a feedback system based upon a harmonic analysis of both the orbit movements and the correction magnetic fields. 14 refs., 6 figs., 2 tabs.

40775 (CRN-HE–88-02) **Development of a multiwire flat cathode chamber with screens for the RICH barrel of DELPHI.** Husson, D. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 194p. (In French). Order Number DE89903313/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A multiwire chamber for the RICH barrel of Delphi is presented. In RICH, the Cherenkov effect is used in a double system of gas and liquid radiators to identify charged particles in jets. Cherenkov imaging requires three dimensional localization of individual electrons. The RICH detectors are multiwire chambers with fine granularity and anode and cathode readout. The chamber has flat cathodes, with the optical insulation of each anode cell (necessary to overcome secondary emission problems) being assured by a system of aluminium screens. Chamber design was aided by electrostatic simulations, to determine absolute collection efficiency in the magnetic field given the presence of the dielectric screens, and to study the best chamber blocking conditions. A prototype flat cathode chamber was tested in UV light and in a pion beam. Tests enabled the Cherenkov rings from a gas radiator to de reconstructed, with good performance as to Cherenkov angle resolution, cathode efficiency, and detector figure of merit.

40776 **Generation of backscattered x-rays within an FEL oscillator for coronary angiography.** Stein, W.E. (Los Alamos National Lab., Accelerator Technology Div., MSJ579, Los Alamos, NM (US)); Newnam, B.E.; Lumpkin, A.H. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

X-rays produced within an infrared free-electron laser (FEL) and imaged with a gated, intensified television camera may provide an inexpensive alternative to the use of synchrotrons for transvenous coronary angiography. The energy of these x-rays is dependent on the electron energy that can be controlled electronically. Variation of the x-ray energy allows radiography above and below the K-edge of a number of elements. Image enhancement can be accomplished by digital subtraction of the radiographs. The x-ray intensities based on photon and electron intracavity powers in the operating Los Alamos 10-μm FEL compare favorably with those obtained from larger and much more expensive synchrotrons and electron storage rings. The FEL x-ray source and gated television camera can be synchronized with different phases of breathing and cardiac motion to allow the study of the heart and blood vessels at various stages of these motions.

44 INSTRUMENTATION

Refer also to citation(s) 39920

4401 Radiation Instrumentation

Refer also to citation(s) 40059, 40310, 40512, 40573, 40592, 40594, 40741, 40776, 40875, 40896, 40964, 40965, 40968, 41051, 41081, 41120, 41124, 41126, 41127, 41128, 41139, 41140, 41142, 41143, 41150, 41220, 41224, 41245, 41269

40777 (ANL-HEP-CP-89-54) **Soudan 2 as a long baseline neutrino detector.** Goodman, M. Argonne National Lab., IL (USA). 25 May 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-8905183-2: Workshop on physics at the main injector, Batavia, IL (USA), 16-18 May 1989). Order Number DE89015696/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In a nine month run with a 150 GeV proton beam and a conventional double horn neutrino beam aimed at the Soudan 2 detector, a search could be made for neutrino oscillations in the mode $\nu_\mu \rightarrow \nu_\tau$. If evidence for oscillations is not found, new limits could be set extending the Δm^2 excluded region from .3 eV^2 to .004 eV^2 at 90% confidence level. 7 refs., 4 figs.

40778 (BONN-ME-89-02) **High pressure drift chamber for photonuclear experiments.** Huthmacher, S.; Arends, J.; Noeldeke, G.; Pruefert, W. Bonn Univ. (Germany, F.R.). Physikalisches Inst. Apr 1989. 10p. Contract BMFT 0234BNCI. (CONF-890231--: 5. international wire chamber conference, Vienna (Austria), 13-17 Feb 1989). Available from Bonn Univ. (Germany, F.R.). Physikalisches Inst.

A cylindrical high pressure drift chamber detector for low energy photonuclear reactions is described. The detector design, the readout system and the track recognition are briefly outlined. In a test setup with external proportional chambers, cosmic rays are used to determine the drift time versus drift distance relation and to check the basic features of the detector. (orig.).

40779 (CONF-890379-11) **Status report on an engineering design study of hermetic liquid argon calorimetry for the SSC [Superconducting Super Collider].** Adams, T.; Davis, M.; DiGiacomo, N.J.; Easom, B.; Gordon, H.; Hupp, J.; Killian, K.; Kroon, P.; Lajczok, M.; Marx, M. State Univ. of New York, Stony Brook, NY (USA). 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-80ER10699. From Workshop on calorimetry for the SSC; Tuscaloosa, AL (USA); 13-17 Mar 1989. Order Number DE89015716/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There is general recognition that engineering issues are critical to the viability of liquid argon calorimetry (LAC) at the Superconducting Super Collider (SSC). We have undertaken to quantitatively address these issues and, if possible, perform a preliminary design of a "proof of principle" LAC for SSC. To establish LAC as viable at SSC, we must demonstrate that the physics performance of the device is acceptable, despite the presence of dead material due to vessels and support structure. Our approach involves the construction, by a team of physicists and engineers, of one three dimensional model of the LAC system, built as a hierarchy of components and structures, from which we directly perform interferences checks, mechanical, thermal and magnetic analyses, particle tracking, hermeticity evaluation, physics simulation and assembly. This study, begun in February 1989 as part of the SSC generic detector R and D program, was immediately preceded by a workshop at which engineering details of existing and planned LAC systems were thoroughly examined. We describe below the status of our work, beginning with short descriptions of the tools used, the study requirements and LAC configuration baseline. We then detail the LAC design as it presently stands, including assembly considerations, and conclude with a quantitative assessment of the LAC hermeticity. 19 refs., 12 figs.

40780 (CRN-CPR-88-10) **Measurement of X-L ray production cross sections of the elements Ba56, La57, and Ce58 by 1 to 3.5 MeV protons.** Kadom-Al-Neami, A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 77p. (In French). Order Number DE89903311/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The cross sections of L rays of Ba, La, and Ce were measured in the energy domain used for PIXE analyses. The measurements are useful in identifying these rays in natural samples such as clays. Their energies are situated in the spectral range from 4 to 6 keV, the same as those of K rays of Ti, V, and Cr, often present in the same samples, thus presenting a risk of confusion. The best results are obtained with thin samples and Rutherford backscattering. Analysis shows that the cross sections of K ray production of Ti, V, and Cr are of the same order of magnitude as those of the L rays of Ba, La, and Ce. It is important therefore to be sure of the presence or absence of these elements.

40781 (CRN-PN-89-1) **Technical characteristics of large volume Ge detectors and the associated electronics.** Duchene, G. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1989. 33p. (In French). Order Number DE89903218/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The efficiency of the multicounter system (12) associated with the crystal palace was increased to improve spectrum quality and to increase double coincidence statistics by a factor of 10. Four large volume Ge, an amplifier, and an integrator were tested. The measuring chain shows good transmission performance, and allows work at very high count rates while maintaining a reasonable mid level energy resolution (2.55 keV). The time response of the detectors is excellent, and is close to that of standard Ge of smaller volume. The crystal palace will be used to study nuclear matter in rapid rotation.

40782 (DOE/ER-0413) **Report of the HEPAP subpanel on major detectors in non-accelerator particle physics.** Department of Energy, Washington, DC (USA). Div. of High Energy Physics. May 1989. 23p. Sponsored by U.S. DOE Energy Research. Order Number DE89013876/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The subpanel on Major Detectors in Non-Accelerator Particle Physics was formed in February 1989 as the result of a letter from Robert Hunter, Director, Office of Energy Research, to Francis Low, Chairman of HEPAP. A copy of the letter is included in the Appendix to this report. The letter referred to the previous report of HEPAP Subpanel on High Energy Gamma Ray and Neutrino Astronomy which had found that several groups of scientists were working on promising new ideas and proposals in non-accelerator high energy physics and astrophysics; this report recommended that panel be formed to evaluate large projects in these areas of science when specific proposals were received by the funding agencies. In concurring with the recommendation, the request to establish this new Subpanel included the following specific charge: Within the context of changing world wide high energy physics activities and opportunities, review as necessary and evaluate the following major research proposals which have been submitted to the Department of Energy and/or to the National Science foundation: DUMAND II, GRANDE, and the Fly's Eye Upgrade.

40783 (DOE/ER/03130-47C) **The use of neural networks in the D0 data acquisition system.** Cutts, D.; Hoftun, J.S.; Sornborger, A.; Astur, R.V.; Johnson, C.R.; Zeller, R.T. Brown Univ., Providence, RI (USA). 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER03130. (CONF-890545-8: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, VA (USA), 15-18 May 1989). Order Number DE89013960/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We discuss the possible application of algorithms derived from neural networks to the D0 experiment. The D0 data acquisition system is based on a large farm of MicroVAXes, each independently performing real-time event filtering. A new generation of multiport memories in each MicroVAX node will enable special function processors to have direct access to event data. We describe an exploratory study of back propagation neural networks, such as might be configured in the nodes, for more efficient event filtering. 9 refs., 3 figs., 1 tab.

40784 (DOE/ER/10699-1) **Experimental high energy physics using electomagnetic energy calorimetry: Progress report.** State Univ. of New York, Albany, NY (USA). Research Foundation.

1989. 124p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-80ER10699. Order Number DE89015017/JAW. Available from NTIS, PC A06/MF A01 - OSTI.

This report discusses the following topics: Central Calorimeter and Installation; End Calorimeters; Calorimeter Calibration and Simulations; Central Drift Chamber Construction; Collider test of Drift Chamber Modules; Electronics and High Voltage System; Tracking Software; Liquid Argon Engineering for the SSC; SSC Experimental Facilities Development; and EMPACT, SSC Experiment Design.

40785 (EUR–12121) **Neutron radiography working group test programme.** Domanus, J.C. Commission of the European Communities, Luxembourg (Luxembourg). Mar 1989. 112p. Available from NTIS (US Sales Only), PC A06/MF A01.

Scope and results of the Euratom Neutron Radiography Working Group Test Program are described. Seven NR centers from six European Community countries have performed this investigation using eleven NR facilities. Four test items were neutron radiographed using 30 different film/converter combinations. From film density measurements neutron beam components were determined. Radiographic sensitivity was assessed from visual examinations of the radiographs. About 25,000 dimensional measurements were made and were used for the assessment of accuracies of dimensional measurements from neutron radiographs. The report gives a description of the test items used for the Test Program, the film density and dimensional measurements, and concentrates on the assessment of the measuring results. The usefulness of the beam purity and sensitivity indicators was assessed with the conclusion that they are not suitable for neutron radiography of nuclear reactor fuel. Ample information is included in the report about measuring accuracies which can be reached in dimensional measurements of fuel pins. After a general comparison of measuring accuracies is discussed. Results from different NR facilities are treated separately as are the different kinds of dimensions of the fuel pins. Finally human and instrument factors are discussed. After presenting final conclusions (which take into account the above-mentioned factors) results of other investigations about dimensional measurements are shortly reviewed.

40786 (FNAL-TM–1591) **Results from the E-705 electromagnetic shower position detector.** Jenkins, C.M.; Arenton, M.; Chen, T.Y.; Conetti, S.; Cox, B.; Delchamps, S.W.; Etemadi, B.; Fortney, L.; Guffey, K.; Haire, M. Fermi National Accelerator Lab., Batavia, IL (USA). Apr 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-881103–65: IEEE nuclear science symposium, Orlando, FL (USA), 9-11 Nov 1988). Order Number DE89014357/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A fine grain hodoscope to measure the position of showers in the outer ($|X| > 52$cm) region of the E-705 electromagnetic calorimeter is described. The hodoscope is constructed with two layers of vertical conducting plastic tubes for the X position measurement of showers. Y position measurement of showers was accomplished by cathode induced horizontal strips. A 50/50 argon, ethane bubbled though isopropyl alcohol at 0°C gas mixture was circulated through the tubes in parallel. The tubes were operated at +1.925 kv on the wire (below the region of saturated avalanche) in the limited proportionality mode. The hodoscope is described and results are presented for the position resolution, shower width, and charge detected as a function of calibration electron energy. 6 refs., 10 figs.

40787 (IFVE-ONF–88-14) **Experimental facility for UNK collider.** Denisov, S.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 15p. (In Russian). Order Number DE89633708/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Structure and basic characteristics of universal calorimetric detector (UCD), used in the UNK colliding beam experiments, are considered. UCD is composed of five sections: central, two face and two external ones. All sections contain tracking systems, electromagnetic and hadron calorimeters and muon spectrometers. The central section also includes vertex detectors, transition radiation detector and superconducting solenoid. The physical research program is briefly discussed. 6 refs.; 7 figs.; 2 tabs.

40788 (INFN-BE–89-1) **Stretcher and holder module.** Guazzoni, P.; Taiocchi, G.; Zetta, L. Istituto Nazionale di Fisica Nucleare, Rome (Italy). 1989. 12p. Order Number DE89633709/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This paper describes the general structure and performance of a compact module, designed to strech anf hold analog signals up to several hundreds of microseconds, without remarkable changes in the pulse height and shape, and to provide a convenient interface between detector systems and data acquisition equipments.

40789 (INIS-mf–11495, pp. 64-66) **Ice thickness and low energy Si(Li) detector.** Cohen, D.D. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Most modern Si(Li) detectors are sealed units relying on the cryopumping action of zeolite placed inside the dewar vacuum system to maintain good vacuum. Microscopic leaks through the thin Be window and the vacuum seals around the dewar pumping mean that the cryostat vacuum deteriorates with time and the pumping action of the zeolite is less efficient. Any water vapour present in the system would naturally condense on the cooled crystal producing an ice layer. Measurements by us since 1982 have shown that a good detector may have between 0 and 20 μm of ice on its front face, while one with more than 40 μm will probably be sweating (surrounded by condensation) a lot and have poor cryostat vacuum. This need to monitor the ice build up with time makes our previous method unacceptable and we report here on a simple technique we have developed to measure this ice thickness, using an ^{241}Am source.

40790 (INIS-mf–11502, pp. 42-48) **Simple model for skin dose measurement.** Ben-Shachar, B. (Pennsylvania State Univ., University Park, PA (USA). Dept. of Nuclear Engineering); Levine, S.H. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Beta particle radiation is strongly absorbed by the skin. In the present work, a new method of determining the beta dose to the skin has been investigated by combining analytic calculations with experimental measurements. The analysis was performed by beta spectrometry and Monte-Carlo computer program based on electron transport theory. The experimental measurements were performed with $Li_2B_4O_7$:Cu TLD chips having different polyethylene shields.

40791 (INIS-mf–11502, pp. 49-52) **Soreq fast neutron personnel dosimeter.** Shamai, Y. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Even, O.; Tal, A.; Eisen, Y.; Schlesinger, T. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40792 (IPNO-DRE–88-30) **Time-of-flight mass measurement in the secondary ion emission process. Application to measurement of high masses.** Le Beyec, Y. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 30p. (In French). Order Number DE89903214/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Time-of-flight mass spectroscopy is reviewed. The equipment is reliable and gives good results in a mass range from 1 to 30,000. Simple apparatus for routine measurements can often replace traditional spectrometers. Various probes can be attached, and an example of a machine operating with three different probes is quoted.

40793 (IPNO-DRE–88-32) **Time-of-flight mass spectrometry with various desorption probes.** Le Beyec, Y. Paris-11 Univ., 91 -

Orsay (France). Inst. de Physique Nucleaire. 1988. 20p. (CONF-8808115--: 11. international mass spectrometry conference, Bordeaux (France), 29 Aug - 2 sep 1988). Order Number DE89903215/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Basic aspects of time-of-flight mass spectroscopy measurements are reviewed according to the desorption-ionisation probes used. The enhancement of mass resolution, the possibility of metastable decay analysis, and the post - ionisation method are mentioned.

40794 (ISN--88-82) **Contribution to the development of the AMPHORA detector. Development of computer control system.** Saint-Martin, J. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 103p. (In French). Order Number DE89903315/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Aspects of the development of the AMPHORA multidetector system are presented. The AMPHORA is a modular system consisting of 140 detectors, covering 81% of the solid angle. Each detector is composed of two scintillators. Two types of detector are available: CsI+NE102 and CSI+NE213. The basic CsI(T1) scintillator allows charge and mass identifications of light ions (protons to lithium). Depending on the make-up of the detector it is possible either to detect neutrons with the NE213 or identify intermediate charge ions, up to neon, with the NE102. The computer system for managing acquisition is based on a multiprocessor design built around a VME bus. A simulation of the multiplicity response of AMPHORA and a study of the response of CDI and the particle separation method are presented. Attention is focused on the data acquisition and computerized control system, including hardware and software., especially the utilization of a Macintosh computer to control the electronics.

40795 (ISN--88-83) **Measuring system for correlations of light particles with low relative linear momentum: operation and first results.** Mistretta, J. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 121p. (In French). Order Number DE89903293/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The EMRIC set up (Ensemble de Mesure Rapide pour l'Interferometrie et les Correlations) is devoted to the study of space and time extent of nuclear sources from the measurement of light charged particles correlations. This device, composed of an array of 16 detectors (CsI crystals coupled to phototubes) used in conjunction with a multiwire chamber, is characterised by a smart granulation, a large solid angle and very small detection dead areas. It opens new possibilities in the measurement of the correlation functions (complete determination (modulus and direction) of the relative momenta in the range 1 to 100 MeV/c). This work describes the development and performances of EMRIC. The mechanics and electronics are detailed to enlighten difficulties inherent to this type of detector. An auxiliary monitoring system has been carried out to simplify some of the experimental tasks. A simulation software code has been written (based on Monte-Carlo techniques) to simulate the effect of the detector on the experimental data. The precision and efficiency in detection place EMRIC, which can be operated in the whole intermediate energy range (10-100 MeV/u), among the most powerful existing devices. First results on the $^{20}Ne + {}^{27}Al$ system are finally shown.

40796 (ISN--89-13) **Study on a prototype and by simulation of an antineutrino detector based on a lithium 6 scintillator.** Ait.Boubker, S. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1989. 115p. (In French). Order Number DE89903295/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

A detector based on Lithium-6 loaded liquid scintillator has been developed by the BUGEY collaboration in order to study neutrino's fundamental properties. This thesis reports on a study concerning a prototype cell of size 85x8.5x8.5 cm^3, of the discrimination properties between neutrons and gammas and thermal neutron identification. Monte-Carlo simulation has allowed us to precise the light collection features in the cell. The last part of this memorandum deals with a cosmic detector presenting 2.5 m^2 active surface. We have obtained for this detector a very good homogenization of light response.

40797 (JINR--13-88-457) **16-channel time interval meter for drift detectors with general stop-signal.** Zamyatin, N.I. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 15p. (In Russian). Order Number DE89633710/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

16-channel time digital converter (TDC-16) for drift detectors and measuring generator of (GS-100) series are described. Time measurement is based on the direct transformation method. Digital interpolator permits to achive time resolution of ±2,5 ns, time measuring range is 0-5,12 ms. Time measurement is possible in the regimes of general start and general stop. The modules are manufactured in CAMAC standard. 6 refs.; 1 fig.; 2 tabs.

40798 (Juel-Spez--444) **Evaluation of gamma spectra (the PIK system).** Nordsieck, H. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz. May 1988. 121p. (In German). Order Number DE89794684/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The program system PIK (Peak Identification Conception) has the aim to identify with automatic methods peaks even in the low-level range with a very low detection limit in the spectrum, and to identify the nuclides generating the peaks. PIK is a search routine program which also covers all measurement and data transfer functions. The main programs are PIKUS (main interpretive program), PIKEN (energy calibration program), PIKEI (activity calibration program), PIKDAT (file editor), and PIKMIN (detection limit program) and other interpretive programs and subroutines. The PIK system has proven a success with various computer-analyzer combinations. (orig./DG).

40799 (KFKI--1989-17/D) **USX and SX radiation measurement of tokamak plasma by MicroChannel Plate.** Kalvin, S.; Bakos, J.S.; Buerger, G.; Kardon, B.; Petravich, G.; Zoletnik, S. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Mar 1989. 18p. Order Number DE89633740/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Rev. Sci. Instrum.

A new method is described for the measurement of soft X-ray (SXR) and ultrasoft X-ray (USXR) radiation of fusion plasmas. The system applies the MicroChannel Plate (MCP) detector and can be used to measure the emitted radiation along 12 channels in different energy ranges. The operation of the MCP in the measurement is discussed in detail. Some results are included which demonstrate the capabilities of the device. (author) 6 refs.; 4 figs.

40800 (LA--11635-M) **Flat-squared counter design and operation manual.** Menlove, H.O.; Palmer, R.; Eccleston, G.W.; Ensslin, N. Los Alamos National Lab., NM (USA). Jul 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89015793/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A well-type neutron coincidence counter has been designed for in-plant applications. The detector has external neutron shielding and special design features to give a uniform efficiency over the sample cavity. In addition, the detector design is relatively insensitive to sample matrix effects. This manual describes the detector design, performance characteristics, and calibration. 3 refs., 16 figs., 2 tabs.

40801 (LA-UR--89-1438) **Near-optimum procedure for half-life measurement by high-resolution gamma-ray spectrometry.** Parker, J.L. Los Alamos National Lab., NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890658--2: International symposium on nuclear decay data: spectrometric methods, measurements and evaluations, Braunschweig (Germany, F.R.), 6-8 Jun 1989). Order Number DE89012599/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A near-optimum procedure for using high-resolution γ-ray spectrometry to measure the half-lives of appropriate γ-ray-emitting-nuclides is presented. Among the important points of the procedure are the employment of the reference source method for implicit correction of pileup and deadtime losses; the use of full-energy peak-area ratios as the fundamental measured quantities; and continuous, high-rate data acquisition to obtain good results in a fraction of a half-life if desired. Equations are given for estimating

the precision of the computed half-lives in terms of total measurement time, number of spectral acquisitions, and the precision of peak-area ratios. Results of ^{169}Yb half-life measurements are given as an example of the procedure's application. 3 refs., 2 tabs.

40802 (LBL–27328) **Speed of response, pile-up, and signal to noise ratio in liquid ionization calorimeters.** Colas, J. Los Alamos National Lab., NM (USA). Jun 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890379–12: Workshop on calorimetry for the SSC, Tuscaloosa, AL (USA), 13-17 Mar 1989). Order Number DE89015344/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Although liquid ionization calorimeters have been mostly used up to now with slow readout, their signals have a fast rise time. However, it is not easy to get this fast component of the pulse out of the calorimeter. For this purpose a new connection scheme of the electrodes, the "electrostatic transformer," is presented. This technique reduces the detector capacitance while keeping the number of channels at an acceptable level. Also it allows the use of transmission lines to bring signals from the electrodes to the preamplifiers which could be located in an accessible area. With room temperature liquids the length of these cables can be short, keeping the added noise at a reasonable level. Contributions to the error on the energy measurement from pile up and electronics noise are studied in detail. Even on this issue, room temperature liquids (TMP/TMS) are found to be competitive with cold liquid argon at the expense of a moderately higher gap voltage. 5 refs., 9 figs., 2 tabs.

40803 (NPL-RS(EXT)–93) **Study of the National Physical Laboratory microdosimetry research programme in collaboration with the University of Leeds.** Menzel, H.G. National Physical Lab., Teddington (UK). Nov 1987. 16p. Order Number DE89633741/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A study of the present programme of work carried out by the National Physical Laboratory and the University of Leeds, has been carried out. The study is based on the use of the tissue-equivalent proportional counter in microdosimetic techniques in radiation protection for monoenergetic neutrons or reference radionuclide neutron sources. This report comments on the programme as a whole and provides recommendations for future research work, taking into account the research programmes carried out at other institutions. It also attempts to summarise the present state of knowledge and experience associated with the application of this technique to radiation fields met in routine radiation protection. (author).

40804 (ORNL/TM–10971, pp. 23-32) **Improved performance of a two-element TLD badge for determining gamma and beta doses using multiple linear regression.** Cipolla, S.J. (Creighton Univ., Omaha, NE (USA)); Powell, R.J.; Stultz, R.K.; Norris, C.; Hawes, M.; Hearty, B. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The gamma/beta TLD badge used by OPPD consists of two TLD-700 chips (Harshaw G7 card), one of which (chip#2) is shielded by a 0.102 cm-thick aluminum filter, and the other (chip#1) is unshielded, as shown in Fig. 1. Standard procedure had been to determine the beta dose to the badge by subtracting the response of chip#2 from that of chip#1 and then dividing by a calibrated beta-sensitivity factor; the gamma dose was taken to be the response of chip#2 divided by the chip's gamma-sensitivity factor followed by the subtraction of the background dose. A problem with this procedure is penetration of energetic beta particles through the aluminum filter on chip#2 which causes an over-response. Due to the technique used to obtain the beta dose, this also results in an under-estimate of the beta dose. This problem has been corrected through application of multiple linear regression analysis on a large data base of pure gamma (^{137}Cs), pure beta (^{90}Sr), and mixed exposures. The outcome of the analysis is an algorithm that automatically corrects for penetration effects. Performance tests using the ANSI N13.11 standard are presented to show the improvement.

40805 (ORNL/TM–10971, pp. 33-42) **Angular energy response of personnel thermoluminescent dosimeters.** Paoshan Weng (National Tsing Hua Univ., Taiwan (China)); Pinchieh Hsu; Tehchao Chen. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The angular energy dependence of the response of two commercial thermoluminescent dosimeter systems was investigated. The first personnel dosimeter investigated was the Radi-Guard which is a multi-area LiF (TLD-700) locked in Teflon matrix and incorporated with a PB-2 holder developed by Teledyne Isotopes. The second one was the BG-7 which is comprised of two LiF (TLD-700) chips developed by Harshaw, but the TH-2 holder was fabricated at National Tsing Hua University. The angle of incidence was varied from perpendicular to parallel for ^{90}Sr-^{90}Y β radiation, ^{241}Am and ^{60}Co γ radiation. Experimental results are presented and discussed.

40806 (ORNL/TM–10971, pp. 43-47) **Linearity of and minimum measurable dose for $Li_2B_4O_7$:Cu and $CaSO_4$:Tm TL-elements used in a personnel/environmental dosimeter.** Hoffman, J. (Pennsylvania State Univ., University Park (USA)); Shachar, B.B.; Catchen, G.L. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The TL-dose response was measured for $Li_2B_4O_7$:Cu and $CaSO_4$:Tm phosphors, in the useful range of personnel and environmental dosimetry (0.005-10 mGy). The relative standard deviations and the corresponding doses were fitted to a semiempirical expression, from which the minimum measurable doses were derived.

40807 (ORNL/TM–10971, pp. 48-59) **Dose determination algorithms for a nearly tissue equivalent multi-element thermoluminescent dosimeter.** Moscovitch, M. (Harshaw Crystal and Electronic Products, Solon, OH (USA)); Chamberlain, J.; Velbeck, K.J. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

In a continuing effort to develop dosimetric systems that will enable reliable interpretation of dosimeter readings in terms of the absorbed dose or dose-equivalent, a new multi-element TL dosimeter assembly for Beta and Gamma dose monitoring has been designed. The radiation-sensitive volumes are four LiF-TLD elements, each covered by its own unique filter. For media-matching, care has been taken to employ nearly tissue equivalent filters of thicknesses of 1000 mg/cm^2 and 300 mg/cm^2 for deep dose and dose to the lens-of-the-eye measurements respectively. Only one metal filter (Cu) is employed to provide low energy photon discrimination. A Thin TL element (0.09 mm thick) is located behind an open window designed to improve the energy under-response to low energy beta rays and to provide closer estimate of the shallow dose equivalent. The deep and shallow dose equivalents are derived from the correlation of the response of the various TL elements to the above quantities through computations based on previously defined relationships obtained from experimental results. The theoretical formalization for the dose calculation algorithms is described in detail, and provides a useful methodology which can be applied to different tissue-equivalent dosimeter assemblies. Experimental data has been obtained by performing irradiation according to the specifications established by DOELAP, using 27 types of pure and mixed radiation fields including Cs-137 gamma rays, low energy photons down to 20 keV, Sr/Y-90, Uranium, and Tl-204 beta particles.

40808 (ORNL/TM–10971, pp. 68-74) **DOE personnel neutron dosimetry evaluation and upgrade program.** Faust, L.G. (Pacific Northwest Laboratory, Richland, WA (USA)); Stroud, C.M.; Vallario, E.J. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the*

second conference on radiation protection and dosimetry. Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The US Department of Energy (DOE) sponsors an extensive research program to improve the methods, dosimeters, and instruments available to DOE facilities for measuring neutron dose and assessing its effects on the work force. The Total Dose Meter was recently developed for measuring in real time the absorbed dose of mixed neutron and gamma radiation and for calculating the dose equivalent. The Field Neutron Spectrometer was developed to provide a portable instrument for determining neutron spectra in the workplace for flux-to-dose equivalent conversion and quality factor calculation. The Combination Thermoluminescence/Track Etch Dosimeter (TLD/TED) was developed to extend the effective neutron energy range of the conventional TLDs to improve detection of fast-energy neutrons. An Optically Stimulated Luminescence Dosimeter is presently being developed for application to gamma, neutron, and beta radiation. An Effective Dose Equivalent System is being developed to provide guidance in implementing the January 1987 Presidential Directive to determine effective dose equivalent. Superheated Drop Detectors are being investigated for their potential as real time neutron dosimeters. This paper includes discussions of these improvements brought about by the DOE research program.

40809 (ORNL/TM–10971, pp. 75-84) **Computational individual neutron dosimetry at the PTB.** Jahr, R. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)); Hollnagel, R.; Siebert, B.R.L. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The investigation of dose meters composed of several detectors is important in individual dosimetry. Computational methods are needed in particular in order to determine certain calibration factors. Calibration methods have been briefly discussed for these composed dose meter systems and a plea made for calibrating the dose meter on an anthropomorphic phantom and not on the ICRU sphere. Computational methods are still needed not only to calculate the fluence-to-dose conversion factors but are also useful for calculating the detector responses as a function of influence parameters. The power of computational methods was illustrated in two examples. First, a system of two albedo detectors was shown to have good dosimetric properties even in radiation fields with unknown directional distributions of incident neutrons. In this case, the effective dose equivalent is an indispensable dose quantity. Secondly, the effect of the influence parameters was studied for dose meter systems of albedo and track-etch detectors worn on the chest. The directional dose equivalent appears to be an adequate dose quantity in this case.

40810 (ORNL/TM–10971, pp. 85-95) **Personnel neutron dosimetry applications of track-size distributions on electrochemically etched CR-39 foils.** Hankins, D.E. (Lawrence Livermore National Lab., CA (USA)); Homann, S.G.; Westermark, J. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The track-size distribution on electrochemically etched CR-39 foils can be used to obtain some limited information on the incident neutron spectral. Track-size distributions on CR-39 foils can also be used to determine if the tracks were caused by neutrons or if they are merely background tracks (which have a significantly different track-size distribution). Identifying and discarding the high-background foils reduces the number of foils that must be etched. This also lowers the detection limit of the dosimetry system. We have developed an image analyzer program that can more efficiently determine the track density and track-size distribution, as well as read the laser-cut identification numbers on each foil. This new image analyzer makes the routine application of track-size distributions on CR-39 foils feasible.

40811 (ORNL/TM–10971, pp. 96-105) **Development and implementation of a fast neutron monitoring system based on plastic track detectors.** Bradley, R.P.; Ryan, R.N. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The Bureau of Radiation and Medical devices has provided neutron dosimetry services for Canadian industrial and research applications since the late 1960's. The program used a nuclear emulsion film, Kodak NTA, as the personal dosimeter. Despite its two principle shortcomings, that of a relatively high energy threshold, approximately 700 keV, and highly labor intensive analysis technique, there was little else conveniently available for use. For quite a number of years we pursued, as did many laboratories, the possibilities of developing an albedo dosimeter based on paired thermoluminescent elements in some form of cadmium and plastic encapsulation. Some promise has been shown by this method and several major laboratories have designed and are currently using albedo dosimeters. At the first symposium on Personnel Radiation Dosimetry held in Knoxville in 1984, Dale Hankins of the Lawrence Livermore Laboratories, in his paper entitled, Improvements in the Etching of CR-39 for Large Scale Neutron Dosimetry, reported on his laboratories work with the polycarbonate, CR-39. Using this paper as a start and following up on similar work by W. G. Cross at the Chalk River Nuclear Laboratories, we have developed a replacement dosimeter. This paper will describe the principle features of the system introduced into routine use in Canada in October 1987.

40812 (ORNL/TM–10971, pp. 126-137) **Time temperature controlled non-contact automatic TLD system methodology for performance evaluation.** Velbeck, K.J. (Harshaw Crystal and Electronic Products, Solon, OH (USA)); Moscovitch, M. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

This paper documents the test procedures and results pertaining to a new four chip TLD dosimeter, TLD card type 8801, when evaluated in the System 8800 TLD card Reader developed by Harshaw. The reader is automatic and uses hot nitrogen gas for non-contact heat transfer. The heating method is unique in the sense that it employs a closely controlled, linearly ramped time temperature profile. Since the overall performance of the equipment used in radiation protection dosimetry has a major role in the final determination of the dose equivalent, we have developed and implemented a methodology for the performance evaluation of the Model 8800 Reader and its associated TL dosimeters. Nine test procedures were performed, including Dose Response and Repeatability, Batch Uniformity, Card Reusability and Endurance, Fading, Thermal Neutron Sensitivity, Residual Signal, and Element Thickness. The results of each test are reported and discussed.

40813 (ORNL/TM–10971, pp. 138-146) **Quality assurance package for routine thermoluminescence dosimetry program.** Tawil, R.A. (Harshaw Crystal and Electronic Products, Solon, OH (USA)); Bencke, G.; Moscovitch, M. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The Quality Assurance Package presented here specifies a set of reader-related hardware diagnostics and calibration procedures and automatically maintains audit trails of generated and derived thermoluminescence data. It specifies acceptable performance criteria for the reader and dosimeter assemblies; tracks and controls Readout Cycle Temperature Profiles; and ensures that the acquired data is verified. The quality of the generated glow curves is tracked by the real-time application of Computerized Glow Curve Deconvolution to reference dosimeters that may be mixed with field dosimeters during readout sessions. This package is supported by a menu-driven software system using vertical auto-selection menus, lotus-style horizontal menus, data entry menus with automatic error checking, and pop-up windows. The menu system is supported by

an extensive HELP file; data EDITING is password-protected, and a journal is maintained for each editing session as part of the audit trail. Files for the Raw Data and Derived Dose results are maintained and managed in seven databases. The paper provides an in-depth analysis of each of the procedures, specifies data validation criteria, and presents samples of the reports generated.

40814 (ORNL/TM–10971, pp. 190-199) **Calibration of neutron sensitive spherical devices with a D_2O-moderated ^{252}Cf source at close distances.** Kluge, H. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)); Weise, K.; Hunt, J.B. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The aim of the present work was to investigate the dependence of the response of spherical devices at much smaller center-to-center separation distances D_o, and to try to explain any departures from the inverse-square law. The response of spherical devices due to a physically small radionuclide source as a function of the separation distance, at both small and large distances, is well understood. Departures from the inverse square-law at close distances can be explained in terms of a geometric correction that takes into account the finite size of the detector and the divergence of the incident neutron fluence. If the response of a spherical device could be understood at such close distances, for a physically large source such as the D_2O-moderated ^{252}Cf source, then calibrations could be carried out over the full operational range of typical devices using neutron sources with relatively low emission rates. This would reduce the initial cost of the source to the calibration laboratory and ease the problems associated with its handling.

40815 (ORNL/TM–10971, pp. 200-205) **Health Physics Society program for accreditation of calibration laboratories.** West, L.; Masse, F.X.; Swinth, K.L. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The Health Physics Society has instituted a new program for accreditation of organizations that calibrate radiation survey instruments. The purpose of the program is to provide radiation protection professionals with an expanded means of direct and indirect access to national standards, thus introducing a means for improving the uniformity, accuracy, and quality of ionizing radiation field measurements. Secondary accredited laboratories are expected to provide a regional support basis. Tertiary accredited laboratories are expected to operate on a more local basis and provide readily available expertise to end users. The accreditation process is an effort to provide better measurement assurance for surveys of radiation fields. The status of the accreditation program, general criteria, gamma-ray calibration criteria, and x-ray calibration criteria are reviewed.

40816 (ORNL/TM–10971, pp. 206-210) **New dosimeter calibration laboratory at ORNL.** Casson, W.H. (Oak Ridge National Laboratory, TN (USA)). Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The Radiation Calibration Laboratory (RADCAL) facility at ORNL was designed to facilitate calibration of instruments and dosimeters in support of work related to the Health Physics Research Reactor. Its role has expanded to include standard dosimeter testing, basic dosimeter research, radiobiology research, and personnel training. The facility is currently operational with two gamma sources, two neutron sources (polyethylene moderated Cf-252 and a PuBe source), and a Sr-Y beta source. A 320 kV x-ray machine is on order and is due for delivery before the end of the year. Also, two heavy water spheres are under construction to provide a standardized source of moderated fission neutrons. An official dedication ceremony is scheduled early in the second quarter of 1989 and it is hoped all sources will be fully operational at that time. This facility provides a major new tool for research in dosimetry at ORNL and is available as a user facility to qualified participants.

40817 (ORNL/TM–10971, pp. 211-218) **Portable single channel analyzer incorporated with a GM counter for radiation protection.** Chenghsin Mao (National Tsing Hua Univ., Taiwan (China)). Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

A compact size of single channel analyzer incorporated with a GM counter has been developed. It measures 8.7 cm (W) x 22.2 cm (L) x 4.4 cm (H) and weighs 0.58 kg excluding the detectors. An adjustable high voltage of 0-1000 V is included with an error of ± 0.1% and powered by three mercury batteries of 9 V each. Both the upper and lower level discriminators are set at 0 - 5 V with an error of ± 1%. The timer can be set at either 0 - 99 sec or 0 - 99 min with a buzzer alarm. The resolution of pulse is 5 μs plus the pulse width. The LCD display is either 3 1/2 or 4 digits. The rise time of shaping circuit is 1 μs with a band width of 350 kHz. The voltage indicator for battery is set at 7.5 V. All integrated circuits are of CMOS with low cost OPAMP. Some examples for field applications are given.

40818 (PTB-Dos–17) **Evaluation of film dosimeter sensors by means of the linear combination of the corrected indications.** Ambrosi, P. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Dosimetrie. Aug 1988. 42p. (In German). Order Number DE89794900/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The evaluation by means of the linear combination of the corrected indications of the fields is suitable for evaluating the measurement films of the film dosimeters of type GD01 and to comply with the requirements of the measurement offices according to (German) Land laws regarding the deviation of measurements. As regards the measurement of the photon equivalent dose, the method of linear combination is nearly as good, in a comparison of measurement deviations, as the method used at present by measurement offices in accordance with DIN 6816. However, the evaluation by means of linear combination is simpler and quicker to do. Three fields must be evaluated and due to the evaluation there are no additional measurement deviations at small dose values. There are also no problems with photon radiations of wide energy spectra. Regarding the measurement of H'(10), a comparison with the previous method of the filter analysis process is not possible, as this has not been used by the measurement offices with regard to H'(10). (orig./DG).

40819 (SLAC-PUB–4795) **Development and construction of the SLD Cerenkov Ring Imaging Detector.** Aston, D.; Bean, A.; Bienz, T.; Bird, F.; Caldwell, D.; Cavalli-Sforza, M.; Coyle, P.; Coyne, D.; Dasu, S.; Dunwoodie, W. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515;AT03-76ER70023. PHY85-12145;PHY85-13808. (CONF-890231–9: 5. international wire chamber conference, Vienna (Austria), 13-17 Feb 1989). Order Number DE89013878/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We report on the development and construction of the Cerenkov Ring Imaging Detector (CRID) for the SLD experiment at the SLAC linear collider. In particular, we outline recent progress in the construction, and results from testing the first components of the barrel CRID, including the drift boxes, liquid radiator trays and mirror system. We also review progress in the construction of the barrel CRID gas radiator vessel, the liquid radiator recirculator system, and the electronic readout system. The development of a comprehensive monitor and control system – upon which the stable operation and physics efficacy of the CRID depend – is also described. 19 refs., 9 figs.

40820 (SLAC-PUB–4875) **Development of CRID [Cerenkov Ring Imaging Detector] single electron wire detector.** Aston, D.; Bean, A.; Bienz, T.; Bird, F.; Caldwell, D.; Cavalli-Sforza, M.; Coyle, P.; Coyne, D.; Dasu, S.; Dunwoodie, W. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Feb 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515.

(CONF-890231–8: 5. international wire chamber conference, Vienna (Austria), 13-17 Feb 1989). Order Number DE89013889/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We describe the R and D effort to define the design parameters, method of construction and experimental results from the single electron wire detectors. These detectors will be used for particle identification using the Cerenkov Ring Imaging techniques in the SLD experiment at SLAC. We present measurements of pulse heights for several gases as a function of gas gain, charge division performance on a single electron signal using both 7 μm and 33 μm diameter carbon wires, photon feedback in TMAE laden gas, average pulse shape, and its comparison with the predicted shape and cross-talk. In addition, we present results of wire aging tests, and other tests associated with construction of this unusual type of wire chamber. 12 refs., 9 figs.

4403 Miscellaneous Instruments

Refer also to citation(s) 40173, 40411, 40676, 41070, 41317

40821 (BFR-R–17-1989) **CFC detection. Equipment and methods to trace CFC-agents.** Andersson, M. Swedish Council for Building Research, Stockholm (Sweden). 1989. 149p. (In Swedish). Order Number DE89902432/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

It is difficult to detect CFC-leaks on large heat pump installations. Therefore it is of interest to survey equipment and methods that facilitate that piece of work. The efforts were in the first place concentrated on equipment by large heat pump installations with a heating power above 1 MW but some types of detection equipment are also suitable for use by small heat pumps. The work was concentrated on one hand on types and carateristics of detection equipment and on the other hand on methods of detection. Also a number of mobile instruments - leak detectors - were tested, both in laboratory and in the field. The object of stationary instruments may be detection for job environment, breakdowns or slow leaks. Equipment suitable for the first two purposes are available in several types and at different prices. Detection of slow leaks is on the other hand much more difficult as normal air change rate around the plant results in extremely low CFC contents in the air also by large leaks, which may yield a loss of CFC of c. 1000 kg per year. Special routines should be introduced to detect those leaks. The report presents results laboratory and field testing of both stationary and mobile instruments for leak detection.

40822 (BNL–42907) **Principles determining the length of time materials can be dated by TL [thermoluminescence], ESR [electron spin resonance] and other trapped charge buildup methods.** Levy, P.W. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8904251–1: Workshop on the length of time materials, Oxford (UK), 11-13 Apr 1989). Order Number DE89015107/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The dating of nonmetallic objects by thermoluminescence (TL), electron spin resonance (ESR), optically stimulated luminescence (OSL), and similar methods is possible only when these objects possess certain properties that determine the length of time that the dating method will be valid. These, and other properties also determine the useful temperature range, the precision, accuracy and other effects that influence the dating procedure. The most important factors that contribute to the dating of rocks and minerals will described. Detailed descriptions will not be attempted. The length of time materials can be dated by TL, ESR and other methods based on tapped charge buildup during irradiation depends on the trap concentration vs. dose curve. If the trap concentration is constant, i.e., independent of dose, the datable period is less than the time required to "fill up" the traps, usually 10^3 to 10^5 Gy. If the trap concentration increases with dose the datable period can be 10^3, or more, times longer. 2 refs.

40823 (CONF-890524–1) **Evaluation of ion trap mass spectrometry for the determination of ambient nicotine.** Wise, M.B.; Higgins, C.E.; Ilgner, R.H.; Guerin, M.R. Oak Ridge National Lab., TN (USA). 1989. 5p. DOE Contract AC05-84OR21400. From EPA/APCA international symposium on measurement of toxic and related air pollutants; Raleigh, NC (USA); 2-5 May 1989. Order Number DE89013061/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A thermal desorption unit has been interfaced directly with a Finnigan Ion Trap mass spectrometer (ITMS) for the identification and quantification of trace organics in air. No chromatographic separation of the desorbed constituents is performed prior to introduction into the mass spectrometer. Instead, positive identification of a compound is made based on its collision induced dissociation (CID) tandem (MS/MS) mass spectrum. Using this technique, as little as 50 pg of a constituent desorbed from resin trap can be characterized and quantified with a sample turnaround time of only 2–3 minutes. 3 refs.

40824 (CONF-890836–1) **High resolution three-dimensional image registration.** Tobin, K.W.; Hunt, M.A.; Jatko, B. Oak Ridge National Lab., TN (USA). 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA (USA); 6-11 Aug 1989. Order Number DE89015067/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes a method of precisely aligning two digitized images prior to a point-by-point comparison of the images. Histogram specification to a reference is used to align the images in the photometric axis. A novel method of estimating the location of the cross-correlation peak using a parabolic surface is given. The accuracy of spatial registration using the method is 1/16 pixel. A hardware implementation and error analysis is also included. 9 refs., 4 figs., 3 tabs.

40825 (IFVE-ONF–88-28) **Fast serial communication module.** Lebedev, A.A.; Medved', S.A.; Mikhajlov, Yu.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 3p. (In Russian). Order Number DE89633753/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Module for communication between two heterogeneous data acquisition systems in SUMMA system is described. The data are stored in a buffer with 2 Kbyte capacity and are transmitted by serial code with 1,8 Mbit/s rate. 2 refs.

40826 (INIS-mf–11985) **Strain measurement technique. Practical applications under specific boundary conditions for enhancing plant safety and availability. Proceedings.** GMA-Bericht. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. 139p. (In German). (CONF-8709451–: Symposium on strain measurement technique: practical applications under specific boundary conditions for enhancing plant safety and availability, Koeln (Germany, F.R.), 24 Sep 1987). Order Number DE89794896/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01.

The 10 contributions are concerned with selected areas of application, such as strain measurements in wood, rubber/metal compounds, sets of strain measurements on buildings, reinforced concrete structures without gaps, pipes buried in the ground and measurements of pressure fluctuations. To increase the availability and safety of plant, stress analyses were made on gas turbine rotors with HT-DMS or capacitive HT-DMS (high temperature strain measurements). (DG).

40827 (INIS-mf–11985, pp. 113-123) **Capacitance high temperature strain transducer by Interatom.** Fortmann, M. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). (CONF-8709343–: 4. safety colloquium on explosion protection, Braunschweig (Germany, F.R.), 9-10 Sep 1987). In *Strain measurement technique. Practical applications under specific boundary conditions for enhancing plant safety and availability. Proceedings.* Order Number DE89794896/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Special strain transducers are necessary to perform structure mechanical experiments on real components under creep-fatigue load.

The new development of the transducer was able to solve the problem. In the meantime, different characteristics of the transducer have been examined and many successful applications have been effected. Some important aspects are given in this report. Up to now the longest operation period has been 24000 h on a pipe at 630°C service temperature in a conventional power station. (orig./DG).

40828 (INIS-mf–11985, pp. 125-134) **The use of capacitive strain gages for creep measurements on components operating at 530°C.** Hofstoetter, P. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.). Abt. Spannungsanalyse und Bauteilpruefung). VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). (CONF-8709343–: 4. safety colloquium on explosion protection, Braunschweig (Germany, F.R.), 9-10 Sep 1987). In *Strain measurement technique. Practical applications under specific boundary conditions for enhancing plant safety and availability. Proceedings.* Order Number DE89794896/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The laboratory experiments carried out and the use of creep test samples and components (pipe elbows made of 14 MoV 63) in use at 530°C have confirmed that capacitative strain gauges are suitable to measure creep in materials. They permit an estimate to be made of the actual total strain and of the time to reach a given limiting strain. Damage due to the creep strain can therefore be assigned and the effect of materials and operation on creep behaviour can be determined. (orig./DG).

40829 (INIS-SU–98, pp. 151) **Automatic system for analyzing surface by the back Rutherford scattering using the EhG-5T accelerator.** Bortnyanskij, A.L.; Garenkov, V.S.; Kirshin, G.F.; Klopenkov, M.L.; Pavlovets, M.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ON-LINE MEASUREMENT SYSTEMS/rutherford scattering; HELIUM IONS; MASS RESOLUTION; MEV RANGE 01-10; SENSITIVITY; SILICON; SPATIAL RESOLUTION; SURFACE PROPERTIES; TIME RESOLUTION

40830 (LA-UR–89-1886) **Measurement and characterization of x-ray spot size.** Mueller, K.H. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890885–3: Flash radiography topical symposium, Portland, OR (USA), 15-18 Aug 1989). Order Number DE89014240/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In planning an x-ray imaging experiment one must have an accurate model of the imaging system to obtain optimum results. The blurring caused by the finite size of the x-ray source is often the least understood element in the system. We have developed experimental and analytical methods permitting accurate measurement and modeling of the x-ray source. The model offers a simple and accurate way to optimize the radiographic geometry for any given experimental requirement (i.e., resolution and dose at detector). Any text on radiography will mention the effects of the finite size of the x-ray source on image quality and how one can minimize this influence by the choice of a small radiographic magnification. The film blur (independent of the source blur) is often treated as a single number and combined with an effective blur dimension for the x-ray source to give a total blur on the film. In this paper, we will develop a treatment of x-ray sources based on the modulation transfer function (MTF). This approach allows us to infer the spatial distribution function of the electron beam that produces the bremsstrahlung x-rays and to predict the performance of an x-ray imaging system if we know the MTF of the detector. This treatment is much more accurate than a single number characterization. 4 refs., 7 figs.

40831 (SAND–88-0495) **Characteristics and development report for the MC3812 radar mechanical design.** Glauner, T.R. Sandia National Labs., Albuquerque, NM (USA). Feb 1989. 68p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89009638/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The MC3812 is the smallest fuzing radar that Sandia Labs. has placed into production to date. The radar weighs less than 1.5 pounds and its volume is approximately 21.5 cubic inches. A single radar housing integrates all subassembly mounting arrangements and provides the mechanical integrity needed to survive severe physical environments imposed on the system. The housing, designed to dissipate high thermal operating loads, also electromagnetically isolates sensitive radar subcircuits from one another. The design makes extensive use of thin film technology for rf circuitry and for the logic circuitry utilizes a multilayer Polyimide-Quartz printed wiring board that permits direct surface mounting of ceramic devices. 35 refs., 35 figs., 1 tab.

40832 (UCRL–101263) **Design, performance, and application of a CCD camera-based CT system.** Martz, H.E.; Skeate, M.F.; Schneberk, D.J.; Azevedo, S.G. Lawrence Livermore National Lab., CA (USA). Jun 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907107–1: American Society of Nondestructive Testing topical conference, Seattle, WA (USA), 24-27 Jul 1989). Order Number DE89014052/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The NDE Section of the Lawrence Livermore National Laboratory (LLNL) provides Laboratory programs with tools needed for the inspection and characterization of materials, components and complete assemblies. X-ray CT is being used to complement conventional radiography as a three-dimensional means of quantitatively measuring material density, uniformity, and flaw dimensions. Laboratory inspection requirements demand diagnostic images with spatial resolutions on the order of tens of micrometers and better than 1% contrast sensitivity. In response to these needs, we are building an experimental CT scanner to develop the technology of high-resolution CT imaging. The scanner uses a charge-coupled device (CCD) camera to acquire two-dimensional images of low density materials. Our initial goal is to achieve quantitative density measurements over a 5-cm^3 sample with 30-50 μm spatial resolution. This paper discusses the CT system we are building and reviews the criteria and issues associated with the design of high-resolution CT scanners. After briefly describing our scanner's hardware configuration, we discuss four important aspects of CT data acquisition. These include choice of scan geometry, source energy, sampling rates, and signal processing to improve the integrity of the acquired data. Next, we stress the necessity for correlating CT system performance (spatial resolution and contrast sensitivity) with measurable parameters of the system. We present analytical results describing the relationship between the system point spread function (PSF) and source-detector blur, as well as the relationship between contrast sensitivity and system noise. We conclude by discussing typical applications and results of our CT scanner. 8 refs.

40833 Laser-heterodyne interferometry with streak camera detection. Feldman, M. (Lawrence Livermore National Lab., Livermore, CA (US)); Salmon, J.T.; Mockler, D. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

Wavefront and frequency characteristics of pulsed lasers are of interest in many applications including laser oscillator design, beam propagation, and atom-field interactions. The authors have used a frequency-stabilized cw ring dye laser as a local oscillator (frequency jitter <1 MHz) in an optical heterodyne interferometer to characterize a pulsed dye laser with base line pulse widths of 40-80 ns. Streak camera detection of the heterodyne interfermogram enabled us to obtain both spatial and temporal information from a single pulse. Local oscillator light was delivered to the interferometer through a single-mode fiber whose collimated output served as both a frequency and wavefront reference. The wave front along a single spatial slice of the beam was monitored as a function of time during the pulse by imaging the interfering wavefronts onto the narrow slit of an electronic streak camera (200-ps resolution), which was read

out with a low-noise CCD camera. Several waves of tilt were introduced between the beams to produce nominally straight carrier fringes perpendicular to the entrance slit of the streak camera. The streak record yields fringes having a slope dx/dt that are proportional to the instantaneous frequency difference between the two lasers.

4404 Well Logging Instrumentation

40834 (INIS-mf–11495, pp. 190-192) **Borehole logging research applied to the resource mining industries - current status at CSIRO.** Borsaru, M. (Commonwealth Scientific and Industrial Research Organization, Port Melbourne (Australia). Div. of Mineral Engineering); Charbucinski, J.; Eisler, P.L.; Huppert, P.; Waddington, P.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

During the past five years, the Borehole Logging Project Group of the CSIRO Division of Mineral Engineering has concentrated an appreciable effort, in addition to that of their applied research, to the development and demonstration of the borehole logging technology, SIROLOG. SIROLOG is an outgrowth of the Group's previous and current research into nuclear borehole probe systems. A suite of various logging techniques for coal mining applications resulted from the Group's work. A similar suite of related methods are now under development for iron ore mining.

45 EXPLOSIONS AND EXPLOSIVES

Refer also to citation(s) 40547

4501 Chemical

Refer also to citation(s) 39868, 40662

40835 (LA-UR–89-431) **Electrostatic sensitivity testing of explosives at Los Alamos.** Larson, T.E.; Dimas, P.; Hannaford, C.E. Los Alamos National Lab., NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–15: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007742/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An electrostatic sensitivity test for determining the handling hazards associated with both new and established explosives has been developed at Los Alamos and is now in routine use. The apparatus is a moving electrode device similar to that described by Kusler and Brown. The energy stored in selected capacitors of a capacitor bank is discharged through the sample of explosive. A unique system of confining the samples with lead foil allows one to measure various degrees of sample response to changes in the electrostatic stimulus. Varying the foil thickness provides information about both the "sensitiveness" and the "explosiveness" of the sample. The lead-foil-confinement technique eliminates the subjective description of the response of a secondary explosive to a marginal stimulus as is common in many explosives tests on secondaries. Variables studied included: particle size, sample weight, electrode material, series resistance, temperature, voltage, sample volume, and degree of confinement. 6 refs., 2 figs., 6 tabs.

40836 (LA-UR–89-432) **NTO development at Los Alamos.** Chapman, L.B. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–14: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007741/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

NTO is an explosive with calculated performance near that of RDX but with sensitivity approaching that of TATB. Possible uses for NTO would be as an alternative to RDX in formulations where a lower sensitivity is desired or as an alternative to TATB where more performance is required without a large increase in sensitivity. Efforts have been concentrated on producing NTO and in testing the performance and sensitivity of NTO and NTO formulations. Two-hundred pounds of NTO have been produced and some performance and sensitivity data have been obtained. Work is being done to determine the diameter effect for large-crystal-size NTO. Additional work is being done to improve the small-charge diameter performance of NTO by adding small amounts of RDX or by changing the crystal size and/or crystal habit of the NTO. 6 refs., 5 figs., 3 tabs.

40837 (LA-UR–89-433) **Decomposition of energetic materials on the drop-weight-impact machine.** Buntain, G.A.; McKinney, T.L.; Rivera, T.; Taylor, G.W. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–13: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007763/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The drop-weight-impact test is heavily relied upon for initial characterization of limited amounts of new energetic materials. The mechanisms for reaction of energetic materials on the drop-weight machine are largely unknown. Partly as a consequence of this lack of understanding, results obtained on the drop-weight machine are often misleading and inconsistent. We are investigating decomposition of explosives on the drop-weight machine using radiometric and spectroscopic methods. Initial radiometric results reveal consistent, sequential emissions for specific impacted explosives that may correspond to time-resolved chemical reactions. A method to quantify the extent of an impact-induced reaction using radiography is discussed. Limited results have also been obtained using time-resolved spectroscopy. 11 refs., 7 figs.

40838 (LA-UR–89-434) **Initiation and detonation measurements on liquid nitric oxide.** Schott, G.L.; Davis, W.C.; Chiles, W.C. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–12: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007762/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Measurements are reported on detonations of homogeneous liquid nitric oxide initially at T = 119 K, ρ_0 = 1.28 g/cm^3. Plane-shock initiation in mirror-covered wedges demonstrated detonation in preshocked material (superdetonation) that overtook the smooth input shock. Its transverse irregularities continued in the unsupported detonation. The input shock ran ca. 3 mm at U_i = 3.8 $\pm$ 0.2 km/s. Behind it the fluid had u_p = 0.89 $\pm$ 0.02 km/s, p = 4.3 $\pm$ 0.03 GPa, ρ = 1.67 $\pm$ 0.03 g/cm^3, and the superdetonation had D^*_{lab} $\approx$6.9 km/s. In 356-mm long graphite tubes with 25.4-mm inner diameter, measured detonation velocity is D = 5552 $\pm$ 3 m/s. Failure diameter in graphite is below 8 mm. Free-surface velocities of 1- and 2-mm aluminum plates terminating the detonation axis were near 1.5 km/s approximately as predicted for CJ flow at D_{cc} = 5564 m/s, u_p = 1.34 km/s impinging on aluminum. Electronic streak photography at d = 20.6 mm in brass registered a smoothly convex detonation front with apparent brightness temperature of 1735 $\pm$ 40 K as it reached an end window asynchronously. 20 refs., 5 figs., 3 tabs.

40839 (LA-UR–89-459) **Molecular models for explosives: Application to NTO [3-nitro-1,2,4-triazol-5-one].** Ritchie, J.P.; Kober, E.M. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–11: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007756/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We calculated structures and energies for several isomers of 3-nitro-1,2,4-triazol-5-one (NTO), using molecular orbital theory. The 1H,4H isomer was found to be lowest in energy. We predict the existence of an additional low-lying form that may either be directly observable or have its existence inferred in experiments. We also calculated some possible forms of the conjugate base of NTO. Finally, we have applied a new method of calculation to predict the geometry of the diaminoguanidinium salt of NTO. 16 refs., 4 figs., 5 tabs.

40840 (LA-UR–89-520) **Vibrational spectroscopic investigations of shock-compressed liquid nitrogen and shock-compressed liquid nitromethane.** Moore, D.S.; Schmidt, S.C. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–10: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007991/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Vibrational spectra of liquid nitrogen and liquid nitromethane shock compressed to several high pressure/high temperature states were recorded using single-pulse multiplex coherent anti-Stokes Raman scattering. Vibrational frequencies were extracted from the data by computer spectral simulation techniques. Vibrational frequencies of liquid nitrogen were found to increase monotonically up to ≈17.5 GPa single shock and ≈30 GPa double shock and then to decrease with further increases in pressure. The consequence of the decrease in vibrational frequency on the Grueneisen mode gamma and its effect on the N_2 equation-of-state is discussed. A model is developed that includes the thermally-excited vibrational state transitions in the synthesized spectral fits of the nitromethane CARS data. The adequacy of the model for interpretation of CARS spectra in both ambient and shock-compressed nitromethane is discussed. 42 refs., 5 figs., 1 tab.

40841 (LA-UR–89-536) **The heterogeneous explosive reaction zone.** Mader, C.L.; Kershner, J.D. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–17: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89007987/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

The calculated reaction zone of PBX-9404 using solid HMX Arrhenius kinetics is stable to perturbations. The calculated reaction zone Von Neumann spike pressure agrees with the experimental observations within experimental uncertainty associated with different experimental techniques. The calculated homogengeous explosive reaction zone thickness is larger than observed for the heterogeneous explosive. The effect of two volume percent air holes on the reaction zone was modeled using the three-dimensional Eulerian reactive hydrodynamic code, 3DE. The air holes perturb the reaction zone. A complicated, time-dependent, multidimensional reaction region proceeds through the heterogeneous explosive. The experimentaliy observed reaction zone characteristic of heterogeneous explosives are mean values of an irregular, three-dimensional reaction region. 20 refs., 6 figs.

40842 (LA-UR–89-601) **Prompt detonation of secondary explosives by laser.** Paisley, D.L. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–9: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89008000/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Secondary high explosives have been promptly detonated by directing a laser beam of various wavelengths from 266 nanometers to 1.06 micron on the surface of the explosives. For this paper "prompt" means the excess transit time through an explosive charge is ~250 nanoseconds (or less) less than the accepted full detonation velocity time. Timing between laser pulse, explosive initiation and detonation velocity and function time have been recorded. The laser parameters studied include: wavelength, pulse length, energy and power density, and beam diameter (spot size). Explosives evaluated include: PETN, HNS, HMX, and graphited PETN, HNS, and HMX. Explosive parameters that have been correlated with optical parameters include: density, surface area, critical diameter (spot size), spectral characteristics and enhance absorption. Some explosives have been promptly detonated over the entire range of wavelengths, possibly by two competing initiating mechanisms. Other explosives could not be detonated at any of the wavelengths or power densities tested. 8 refs., 12 figs., 1 tab.

40843 (LA-UR–89-689) **Chemistry of nitromethane at very high pressure.** Agnew, S.F.; Swanson, B.I.; Kenney, J.; Kenney, I. Los Alamos National Lab., NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890811–7: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89008016/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Decomposition of nitromethane is reported over the range of 115-180°C and 0.6-8.5 GPa. About 5 μg of nitromethane is compressed with a diamond-anvil cell, heated to the point that reaction occurs, and held typically 10-20 minutes at the reaction temperature. The cell is cooled and the volatile contents of the cell are frozen as a thin layer in vacuo and an infrared absorption spectrum is recorded. The three volatile products observed are N_2O, CO_2, and water, with N_2O production peaking at 1.5 GPa, 135°C, and 35% of NME; CO_2 production peaking at 3.5 GPa, 135°C, and 65% of NME, and water yields at 20-50% of NME at the highest pressure measured, 8.5 GPa and 175°C. Water yields were difficult to quantify due to background contamination. Results indicate three different reactions for solid NME dependent primarily on the pressure of the reaction, and that fluid NME does not decompose at 0.6 GPa and 175°C, although the solid decomposes readily at 1.1 GPa and 120°C. The authors conclude that, while various decomposition mechanisms are possible, the initial step $CH_3NO_2 \rightarrow \cdot CH_3 + \cdot NO_2$ is very unlikely. 14 refs., 5 figs.

40844 (LA-UR–89-872) **Surface-burn model for shock initiation.** Partom, Y.; Wackerle, J. Los Alamos National Lab., NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–23: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89009387/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An investigation of a surface-burn of the shock-induced decomposition initiation and detonation of heterogeneous explosives is described. The model assumes a microscale process with hot spots ignited by viscoplastic heating at the boundaries of collapsing pores. A relatively thin reaction zone, or burn surface, is driven by the conduction of the heat of reaction, and has a surface-burn velocity with an Arrhenius dependence on the temperature of the unreacted solid component. Global reaction rates are derived from the microscale model with an empirical burning topology function and a macroscopic reactant-product mixture defined by pressure equilibrium, ideal mixing of specific volume and internal energy,and isentropic response of the unreacted constituents. With simplifying assumptions, the model is extended to treat multi-component explosives. The model is implemented into a method of characteristics hydrocode and shown to be effective in simulating several examples of initiation experiments on TATB explosives. 10 refs., 9 figs.

40845 (LA-UR–89-1345) **Heat of detonation, the cylinder test, and performance munitions.** Akst, I.B. Los Alamos National Lab., NM (USA). 1989. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–24: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89011172/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Heats of detonation of CHNO explosives correlate well with copper cylinder test expansion data. The detonation products/calorimetry data can be used to estimate performance in the cylinder test, in munitions, and for new molecules or mixtures of explosives before these are made. Confidence in the accuracy of the performance estimates is presently limited by large deviations of a few materials from the regression predictions; but these same deviations, as in the insensitive explosive DINGU and the low carbon systems, appear to be sources of information useful for detonation and explosives research. The performance correlations are functions more of the detonation products and thermochemical energy than they are of the familiar parameters of detonation pressure and velocity, and the predictions are closer to a regression line on average than are those provided by CJ calculations. The prediction computations are simple but the measurements (detonation calorimetry/products and cylinder experiments) are not. 17 refs., 5 tabs.

40846 (SAND–88-2292C) **Theoretical model of explosive detonation products: Tests and sensitivity studies.** Kerley, G.I. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–3: 9. international symposium on

detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89006770/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

At the 8th Detonation Symposium, we described a (nearly) a priori theory for calculating equations of state (EOS) for the detonation products of explosives. Two main conclusions emerged from that work. First, we found that the ideal mixing approximation gave surprisingly accurate results. The most important advantage of ideal mixing is that it enables one to include much more realistic models for complicated chemical species than would be possible using mixture theories based upon simple intermolecular pair potentials. Second, we showed that formic acid (HCOOH), which has been overlooked in most other theoretical work, is an important reaction product for explosives having a negative oxygen balance (OB). The purposes of this paper are to justify the foundations of our theory, to discuss tests and sensitivity studies of the calculations, and to present some new results and comparisons with experimental data. We begin with an overview of the model and its predictions of explosive detonation properties, overdriven Hugoniot data, and Hugoniots for nonexplosive CHNO compounds. Next we discuss some Monte Carlo calculations of the EOS for mixtures in the pressure-temperature regime relevant to detonations. We also discuss several ways to estimate EOS parameters of formic acid, for which there are very few experimental data. We show that our EOS parameters are reasonable and that EOS uncertainties do not alter the fact that HCOOH is an important reaction product. Finally, we discuss some revisions to our model for the carbon EOS and phase diagram. The revised carbon EOS indicates that melting is partly responsible for the change in slope of the curve of TNT detonation velocity vs. density. 24 refs., 4 figs., 1 tab.

40847 (SAND–89-0180C) **Output measurements and modeling of HNS mild detonating fuse.** Jungst, R.G.; Kipp, M.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–4: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89006443/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The explosive output characteristics of HNS in aluminum sheath mild detonating fuse (MDF) have been measured with VISAR and compared to results from HNAB in aluminum or PETN in lead sheath MDF. Peak particle velocities generated in PMMA windows by detonating HNS MDF were found to decrease for smaller sample diameters and pulse widths narrowed to approximately 0.35 us at half maximum for a 2 grain/foot core load. Implications of this pulse shape for acceptor initiation from MDF are discussed. A trailing peak whose separation from the detonation front increased regularly with increasing sample diameter was consistently present in the particle velocity records. Numerical calculations revealed that a reflected wave from the inner wall of the MDF sheath converges on axis behind the detonation front to form this feature. The effect of sheath material properties and detonation front curvature on the amplitude and position of this trailing peak were also investigated. 8 refs., 8 figs., 2 tabs.

40848 (SAND–89-0196C) **Design and development of precision linear shaped charges.** Vigil, M.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–2: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89006504/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Precision Linear Shaped Charge (PLSC) design concept involves the independent fabrication and assembly of the liner (wedge of PLSC), the tamper/confinement, and explosive. The liner is the most important part of an LSC and should be fabricated by a more quality controlled, precise process than the tamper material. Also this allows the liner material to be different from the tamper material. The explosive can be loaded into the liner and tamper as the last step in the assembly process rather than the first step as in conventional LSC designs. PLSC designs are shown to produce increased jet penetrations in given targets, more reproducible jet penetration, and more efficient explosive cross-sections using a minimum amount of explosive. The Linear Shaped Charge Analysis Program (LSCAP) being developed at Sandia National Laboratories has been used to assist in the design of PLSCs. LSCAP predictions for PLSC jet penetration in aluminum targets, jet tip velocities and jet-target impact angles are compared to measured data. 8 refs., 19 figs., 1 tab.

40849 (SAND–89-2504C) **Compressive combustion of granular materials induced by low-velocity impact.** Baer, M.R.; Nunziato, J.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–25: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89014900/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A reactive multiphase mixture model is used to describe the initiation and compressive combustion of granular energetic materials induced by dynamic compaction. Incorporated in this description is a two-step combustion model whereby compressive reaction is initiated by dynamic compaction. Subsequent energy release from the reaction gases evolved during compaction is delayed following an induction rate law based on time-to-reaction experimental data. Given conditions of sufficient energy release and heat transfer grain burning is initiated when granular surface temperatures exceed decomposition conditions. Model parameters are formulated for the granular explosive HMX and for nitrocellulose-based ball propellants. This model is used to simulate the low-velocity impact experiments of Sandusky and coworkers. Numerical calculations compare well with experimental observations. Details of compaction and combustion behavior are illustrated near the threshold of deflagration-to-detonation transition (DDT). 31 refs., 17 figs., 1 tab.

40850 (UCRL–100644) **Absorption spectroscopy of shocked benzene.** Holmes, N.C.; Otani, G.; McCandless, P.; Rice, S.F. Lawrence Livermore National Lab., CA (USA). Feb 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890811–22: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE89008826/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have used absorption spectroscopy to observe the formation of carbon particles as a separated phase during the passage of strong shock waves in samples of liquid benzene (C_6H_6). The use of a two-stage light-gas gun allows the study of this phenomenon as a function of shock pressure near the reaction threshold at about 13 GPa. Time resolved measurements of sample opacity were performed along with absorption spectra obtained during a 60 ns interval during shock passage. The rate of formation of the particles is rather slow, but is strongly dependent on the final pressure and temperature achieved in the shock loading process. 6 refs., 5 figs.

4502 Nuclear

Refer also to citation(s) 40194, 40195

40851 (SAND–88-3422) **AlGaAs/GaAs radiation-hardened photodiode for optoelectronic component applications.** Rose, B.H.; Keefe, R.G. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 49p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014338/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many optoelectronic components for weapons systems application require photodetectors for converting optical signals to electric signals. These detectors generally require radiation tolerance and must be amenable to high reliability fabrication processes. This report describes the features of an $Al_{.3}Ga_{.7}As/GaAs$ photodiode which has been designed to operate in ionizing radiation environments. It was first developed in the Compound Semiconductor and Device Research Department (1140) at Sandia National Laboratories. Much of the work described here has been done in order to establish reliable sources for the diode in the private sector to supply the DOE nuclear weapons production complex. We describe the device structures and measurements on the diode which provide information about the quality of the layer growth processes. We summarize the status of the project and point out areas for future

work on the device. Finally, we include an Appendix containing calculations of the energy band bending in the active region of the diode. 9 refs., 23 figs., 2 tabs.

40852 (SAND–89-1369) **Safety degradation scenarios for unique-signal-event representations.** Cooper, J.A. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 22p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014351/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Unique signals are used to convey human intent to use a nuclear weapon. The unique signal concept comprises a set of "first principles," including independent communication of engineered pattern (sequence) of event "types." Proper implementation of the complete unique signal concept would satisfy current nuclear safety communication requirements. Unfortunately, some implementation techniques commonly used in ordinary communication and processing could cause significant safety degradation if applied to unique signal transmission, and would therefore not be appropriate for conveying unique signal information. Two scenarios are described in this report to illustrate how improper implementation could create safety vulnerabilities. One scenario involves the use of error correction for individual event representations in conjunction with "dependent" event communication. The other is the use of chained encryption for individual event representations in conjunction with dependent event communication. Both of these techniques could allow commonly used communication sequences to be interpreted as the engineered unique signal pattern. The conclusion is that event-error correction (distance-based logical conversion of all received words to one of two event types), chained-event encryption (feedback-enhanced encryption of event types), and dependent event communication should be used. 5 figs., 2 tabs.

40853 (UCID–21713) **Start and bomber survivability.** Speed, R.D. Lawrence Livermore National Lab., CA (USA). May 1989. 60p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014371/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The survivability of the strategic bombers, while important today, is likely to be viewed as being of even greater importance in the 1990s if the US makes drastic cuts in its strategic forces as proposed in START and possible follow-on treaties. The analysis in this paper indicates that the Soviets with only a few SSBNs could pose a serious threat to the survivability of the strategic bombers (as presently based) if they moved these SSBNs close to the coasts or developed short-time-of-flight trajectories for their SLBMs. In searching for ways to improve bomber survivability, the use of the proposed LPS (Limited Protection System) ABM to defend bomber bases was examined, but found to offer marginal improvement, at best. However, a significant improvement in survivability against even severe threats could be achieved if the alert bomber forces were rebased at a large number (preferably 40 or more) of separate bases distributed in a region in the interior of the country with the closest base being at least 500 nmi from the coasts.

40854 (UCID–21788) **Optimal allocation and effectiveness of midcourse interceptors in a layered defense.** Cunningham, C.T. Lawrence Livermore National Lab., CA (USA). 19 Apr 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013973/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Adaptive preferential employment of interceptors in midcourse ballistic missile defense is considered. The defense discriminates decoys, with such discrimination characterized by a K-factor, and determines optimal intercepts and salvo structure in shoot-look-shoot scenarios. The attacker's strategy to determine proper allocation of warheads to targets of varying value in the presence of a defense is also described. Representative results are presented for the effectiveness of the preferential midcourse defense by itself and in conjunction with a random-subtractive boost/deployment phase defense tier. Quality of discrimination is by far the strongest determinant of performance; the ability to perform a shoot-look-shoot is also important. Inventory requirements for midcourse and boost-phase defenses are determined for missions in which target value saved is the goal, for representative defense parameters. Based on these results, the midcourse tier appears to be a necessary component of a cost-effective defense. 4 refs., 11 figs., 2 tabs.

4503 Explosion Detection

40855 (UCID–21720) **The underground electromagnetic pulse: Four representative models.** Wouters, L.F. Lawrence Livermore National Lab., CA (USA). Jun 1989. 49p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013976/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

I describe four phenomenological models by which an underground nuclear explosion may generate electromagnetic pulses: Compton current asymmetry (or "Compton dipole"); Uphole conductor currents (or "casing currents"); Diamagnetic cavity plasma (or "magnetic bubble"); and Large-scale ground motion (or "magneto-acoustic wave"). I outline the corresponding analytic exercises and summarize the principal results of the computations. I used a 10-kt contained explosion as the fiducial case. Each analytic sequence developed an equivalent source dipole and calculated signal waveforms at representative ground-surface locations. As a comparative summary, the Compton dipole generates a peak source current moment of about 12,000 A·m in the submicrosecond time domain. The casing-current source model obtains an equivalent peak moment of about 2×10^5 A·m in the 10- to 30-μs domain. The magnetic bubble produces a magnetic dipole moment of about 7×10^6 A·m^2, characterized by a 30-ms time structure. Finally, the magneto-acoustic wave corresponds to a magnetic dipole moment of about 600 A·m^2, with a waveform showing 0.5-s periodicities. 8 refs., 35 figs., 7 tabs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

Refer also to citation(s) 39860

40856 (PNL–6905) **Abstracted publications related to the Hanford environment, 1980 to 1988.** Becker, C.D.; Gray, R.H. Pacific Northwest Lab., Richland, WA (USA). May 1989. 162p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014369/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This abstracted bibliography provides a reference to the diverse environmental activities conducted on the Hanford Site from 1980 through 1988. It includes 500 reports and articles that were prepared largely by onsite contractors and the Department of Energy. Documents contained here were separated into eight subject areas: air and atmosphere, aquatic ecology, effluents and wastes, geology and hydrology, Hanford Site, radioactivity, terrestrial ecology, and socioeconomics. These areas form the basis of a key word index, which is intended to help the reader locate subjects of interest. An author index is also included.

5001 Basic Studies

Refer also to citation(s) 40581

40857 (CRIE–T-87069) **Method of analysing land and sea breeze by using stream line pattern classification.** Senshu, Tokio; Kato, Hisayuki. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jul 1988. 67p. (In Japanese). Order Number DE89760376/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In the case of analyzing the environmental density in a certain area, it is desirable for the meteorological characteristics to have been made clear in advance. Particularly, the horizontal distribution of both wind direction and velocity, closely related with the environmental density, is important. That distribution of both wind direction and velocity, and the stream line in field, determined by the synoptic scale meteorological, topographical and other conditions, come to be a specific pattern for the area. Then, a method to objectively

classify such a stream line pattern was studied. Specially, of the local breeze in the Kanto District, the frequency pattern, by using the hourly ground surface stream line, weather, atmospheric pressure distribution and other charts, was discussed. As a result in the Kanto District, there were known to be three categories of sea breeze, i.e., east breeze wide area system generated off Kashima and Boso, south-west breeze wide area system done in the Bay of Sagami and breeze system surrounding the Bay of Tokyo. While there were known to be two categories of land breeze, i.e., north breeze system almost covering the entire Kanto District area and breeze system surrounding the Bay of Tokyo. 17 references, 28 figures, 3 tables.

40858 (STEV-VIND–89-7) **Coastal modification of atmospheric air flow.** Bergstroem, H. Statens Energiverk, Stockholm (Sweden). 1989. 18p. Order Number DE89902468/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Data on the mean and turbulent wind field in a coastal region with about 20 m high rocky hills have been studied. Comparisons with theories for flow-over-hill and internal boundary layer growth have shown reasonable agreement with the data, in spite of the inhomogeneous character of the terrain. (author).

5002 Chemicals Monitoring and Transport

Refer also to citation(s) 39850, 39862, 40374, 41067

40859 (ANL–88-31, pp. 62, Paper 1) **Atmospheric physics program.** Argonne National Lab., IL (USA). Jul 1988. In *Environmental Research Division technical progress report: January 1986-October 1987.* Order Number DE88016165/JAW. Available from NTIS, PC A12/MF A01.

The Atmospheric Physics Program at ANL conducts research on the transport, chemical transformation, and deposition of trace substances in the fluid environment. In 1986, issues of acid rain continued to be the motivation behind most of our research activities. Other sustained activities included studies of atmospheric transport and dispersion over complex terrain and of the physical and chemical behavior of trace substances in the Great Lakes. This chapter summarizes the orientation and some of the progress made in our research projects in 1986.

40860 (CRIE–U-87072) **Studies on the combined effect of low levels air pollutants on plants. 4 Relationship between intraspecific difference of O_3 sensitivity and O_3 and/or SO_2 uptake rate in kidney bean.** Sato, Shusei; Ogawa, Tadashi; Kono, Yoshihisa. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 16p. (In Japanese). Order Number DE89772349/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

By measuring the uptake rate in kidney bean of O_3 and/or SO_2, as dry acid falling gas in atmosphere, the relationships of air pollutant uptake rate with both the sensitivity and environmental factors were discussed. The O_3 uptake rate increases with the increase in gas density, but intraspecifically differs with the difference in sensitivity. The intraspecific difference is based on the difference in gas phase diffusive conductance (DC), index of stomatal aperture. The DC lowered, with the lowering in light intensity, followed by the lowering in gas uptake rate per unit density, propotionally to the DC. While, O_3 and SO_2 did not differ in uptake rate. Against high and low density CO_2, stomatal closure and enlargement (lowering and heightening in DC), respectively, occur. By changing CO_2 in density, co-existent O_3 was measured in uptake rate. Notwithstanding the change in CO_2 density, the O_3 uptake rate, regardless of it, was proportional to the DC. Similarly, the change in humidity changes the DC, but without the difference in O_3 uptake rate. 8 figures, 15 tables.

40861 (DOE/OR/21400–T379) **Carbon dioxide releases from fossil-fuel burning: Statement before the Senate Committee on Energy and Natural Resources.** Marland G.; Boden, T. Oak Ridge National Lab., TN (USA). 26 Jul 1989. 34p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015892/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Discussion of the anthropogenic emissions of carbon dioxide to the atmosphere is given. There are three kinds of human activity that are currently resulting in net release of carbon dioxide (CO_2) to the atmosphere: burning fossil fuels, converting tropical forest area to other land use, and manufacturing cement. Although it is a comparatively small source of CO_2, cement manufacture involves the calcining of limestone (calcium carbonate) to produce calcium oxide. The associated CO_2 emissions are included in the figures that follow. Production of one metric ton of cement results in the release of 0.136 metric tons of carbon as CO_2. (This does not count the fuel used in the processing). When forest area is cleared and converted to land uses that have smaller inventories of carbon in the biota and in the surface liter and soil, there is a net release of carbon to become CO_2 in the atmosphere. Every cubic meter of timber burned releases about 0.26 metric tons of carbon as CO_2 to the atmosphere, and forest clearing generally results in a release of additional carbon from the soil and surface litter. When fossil fuels are burned, carbon that has been long stored in the earth is oxidized and released to the atmosphere as CO_2. Because fossil-fuel burning releases heat from the oxidation of both carbon (to produce carbon dioxide) and hydrogen (to produce water), and because the different fuel forms contain different ratios of carbon to hydrogen, the amount of CO_2 produced per unit of energy released is different for the various fuel forms. 14 figs.

40862 (ESC-WR–89-12) **CH_4/CO-emission from fossil fuels global warming potential.** Okken, P.A.; Kram, T. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Jul 1989. 29p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Paper prepared for the IEA/ETSAP-workshop, Paris, France, June 1989.

CO_2 (carbon dioxide) contributes to the greenhouse effect. Substitution of coal/petroleum fossil fuels to natural gas is one of the options to reduce CO_2-emissions from the energy system. The specific CO_2-emission from natural gas is less and the energy conversion efficiency in stationary applications (power plants, boilers) is in general higher compared to coal/petroleum fuels. Natural gas has been identified as a possible transient fuel to delay greenhouse warming. Concerns have been raised about CH_4-emissions from increased natural gas use (e.g. pipeline leakages). CH_4 is a greenhouse gas. The infrared absorption of one molecule of CH_4 is 30 to 35 times as large as the ir absorption of one CO_2-molecule. This has lead several authors to suggest that leakage of natural gas, even of small quantities, would offset the advantage of its lower CO_2-emission. However the effective atmospheric lifetime of CO_2 is longer than of CH_4. Moreover the atmospheric lifetime of CH_4 is to some extent determined by the magnitude of CO (carbon monoxide) emissions. CO and CH_4 compete for .OH as atmospheric sink, although CO itself is not a greenhouse gas (no ir absorption). This report addresses the question whether fuel switching would effect greenhouse effect mitigating strategies if CH_4 as greenhouse gas is taken into account. The global warming is calculated from current energy related CH_4- and CO-emissions as 'CO_2-equivalent'. This is a straight-forward 'back-of-the-envelope' calculation extracted from various recent quantitative synthesis reports on the greenhouse issue. 2 figs., 39 refs., 3 tabs., 1 app.

40863 (PNL-SA–17093) **Approaches to determining source-receptor relationships.** Hales, J.M.; Renne, D.S. Pacific Northwest Lab., Richland, WA (USA). May 1989. 28p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89015840/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During the past several years, regional and global environmental issues such as acidic deposition and ozone transport have grown in importance. In dealing with these issues, policy analysts have sought solutions that are supported by the scientific processes involved. Source-receptor relationships represent a conceptual basis for incorporating our understanding of these processes into a policy-relevant decision framework. The term "source-receptor relationship" is commonly applied to describe composite behavior exhibited by a pollutant from the time that it is emitted to the atmosphere until the time it arrives at its ultimate point of reception. The term "reception"

is used here to depict either deposition, or simply observation in the gaseous phase by some type of real or hypothetical monitoring device, at any specific location on the earth's surface. Any reduction in uncertainty would directly enhance the quality of associated policy analyses. The objectives of this paper are to examine current techniques being applied by the scientific community and to briefly indicate some of the findings resulting from these efforts. It should be noted that several rather extensive reviews of source-receptor analysis have been published. Our emphasis, rather, will be to advance some quantitative terminology for various source-receptor concepts and to consider briefly several areas where these concepts are being applied. Citations to key literature sources are provided to aid the reader interested in more detailed pursuit of this general subject area. 27 refs., 1 tab.

40864 (UCID–21690-Com.) **Comments on Hamaker's hypothesis of a coming CO_2-induced ice age.** MacCracken, M.C. Lawrence Livermore National Lab., CA (USA). Jun 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. Order Number DE89013981/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Over the past several years, John Hamaker and a number of followers have put forth a hypothesis that the imminent demise of the world's forests from lack of vital mineral nutrients will trigger an ice age. Their evidence in support of this hypothesis has recently appeared as a videotape entitled "Stopping the Coming Ice Age." These comments were prepared in response to the arguments presented on this tape, which several people have suggested presents a highly important scientific analysis unfairly receiving too little attention. I will focus primarily on analysis of the climatic aspects of the Hamaker hypothesis. The videotape attempts to put forth a coherent and appealing story, but does so by taking comments of some scientists out of context, by quoting some scientists out of their field of expertise, by skimming over some serious shortcomings, by facile assumptions not easily spotted by the non-specialist, and by mixing in many true statements (which makes it especially difficult for the lay listener to spot the problems). Overall, these actions combine to make the presentation of the hypothesis very appealing, but also very deceptive.

40865 Determination of polynuclear aromatic hydrocarbons and mononitrated derivatives in air and diesel particulates. Niles, R. (USDOE Environmental Measurements Lab., New York (USA)); Tan, Y.L. *Analytica Chimica Acta (Netherlands),* 221(1): 53-63 (1 Jun 1989).

A method is described for the determination of three- to six-ring polynuclear aromatic hydrocarbons (PAHs) and mononitrated PAHs (nitro-PAHs) in particulate matter. The procedure includes Soxhlet extraction followed by fractionation using gel filtration chromatography and normal-phase liquid chromatography with an aminosilane stationary phase. The resulting fractions were separated by capillary gas chromatography (GC) into individual PAHs and nitro-PAHs which were detected by a flame-ionization detector and a thermal energy analyzer, respectively. Commercially available standards were used for quantification. Individual peak assignments were confirmed by using both mass spectral and retention index data obtained through computerized capillary GC-mass spectrometry. Several samples were processed, including a certified diesel particulate reference material supplied by the National Bureau of Standards for the purpose of evaluating analytical methods. This method may also be applicable in the determination of certain carbonyl PAHs. 4 figs., 14 refs., 2 tabs.

40866 The greenhouse effect and increasing energy use. Chandler, W.U. (Battelle Pacific Northwest Laboratories (USA)). *Energy in Japan (Japan),* (97): 9-23 (May 1989). (CONF-8901137–: Symposium on the Pacific coal flow cooperation, Tokyo (Japan), 25 Jan 1989).

An international effort is needed to keep atmospheric carbon dioxide levels below a doubling relative to pre-industrial levels. Results suggest that climatic change can be slowed with measures which are in many nations' own self-interest as energy efficiency measures both decrease carbon emissions and increase per capita incomes. International cooperation for transfer of technology and knowledge for energy efficiency could provide global benefits. 12 figs., 5 tabs.

5003 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 39948, 40316, 40882, 40963

40867 (EUR–11226) **Nuclear accident at Chernobyl, April 1986. Repercussions on the food chain and on man.** Cazzaniga, R.; Dominici, G.; Malvicini, A.; Sangalli, E. Commission of the European Communities, Luxembourg (Luxembourg). 1987. 156p. (In Italian). Available from NTIS (US Sales Only), PC A08/MF A01.

Because of the nuclear accident of Chernobyl, the Radiation Protection Division of the Ispra Establishment of the J.R.C. of the Commission of the European Communities organized a task-force for the collection, the measurement, the processing and the evaluation of all the useful and necessary elements for the correct management of a state of emergency. This publication particularly shows the measurements of the concentration of radionuclides in the air at the ground level, in vegetables, grass, milk, wheat, in some kinds of meat and the concentration of radioactive iodine and cesium in people of different place of origin. Results are compared to similar measurements carried out from 1960. The estimate of the dose equivalent absorbed by the population of the North - Western Italy concludes this publication.

40868 (EUR–11826) **Chernobyl radioactivity in grain produced in Greece in 1986.** Dominici, G.; Malvicini, A.; Panetsos, F. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 26p. Available from NTIS (US Sales Only), PC A03/MF A01.

The Chernobyl radioactive cloud reached Greece in the first days of May 1986. During this period, the gain was in maximum growth; therefore, in absorbing the radionuclides it has become an excellent indicator of the deposited radioactivity. Measurements carried out in grain samples which were obtained from Greece are reported and some conclusions regarding population doses are presented.

40869 (EUR–11828) **Brasimone study (brastud) an investigation of atmospheric dispersion over complex terrain.** Cagnetti, P.; Ocone, R.; Racalbuto, S.; Desiato, F.; Gaglione, P.; Pfeiffer, W.; Thomas, P.; Vogt, S. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 73p. Available from NTIS (US Sales Only), PC A04/MF A01.

An investigation of atmospheric dispersion over complex terrain was carried out in September 1984 and in June 1985 at the Brasimone Energy Research Centre (B.E.R.C.). This place, where an experimental nuclear reactor is under construction, is located in the Tuscan-Emilian Appennine range approximately 50 km south of Bologna. The measuring campaigns, based on survey of wind and temperature parameters, tracer (SF_6) experiments and tracking of tetroons by radar, were performed with the purpose of assessing the atmospheric dispersion of pollutants under nocturnal drainage flow conditions. The three-dimensional MATHEW/ADPIC model was evaluated with the Brasimone data set and the results obtained are satisfactory.

40870 (INIS-mf–11464) **Radioactivity monitoring in Ireland of air, deposition and water 1982-1987.** Sequeira, S.; McRandall, M.; Hayden, E.; Cunningham, J.D. Nuclear Energy Board, Dublin (Ireland). Feb 1989. 17p. Order Number DE89619715/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Nuclear Energy Board in conjunction with the Meteorological Service undertakes an environmental radioactivity monitoring programme with the objective of determining levels of artificially produced radioactivity in the Irish environment. The levels of radioactivity in airbourne dust, total fallout samples, precipitation and drinking water are presented for 1982, 1983, 1984, 1985, 1986 and 1987.

40871 (INIS-mf–11502, pp. 83-84) **Radioactive fallout measurements of Soreq NRC, Israel-1987.** Shamai, Y. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Dukhan, R.; Even, O.; Schlesinger, T. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number

DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40872 (Juel-Spez–449) **Studies on the long-term atmospheric dispersion factor and the washout factor. Calculation of the contamination of the vegetation by means of the meteorological whole-year or summer statistics?.** Pomplun, E.; Heinemann, K. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz. 1988. 53p. (In German). Order Number DE89794685/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Long-term dispersion factors and washout factors constitute important reference values for the estimation of possible cases of environmental pollution caused by the long-term emission of pollutants from point sources. The nature of these factors permits a relatively quick quantification of dose if the source strength of a nuclide or nuclide mixture is known. Essential input parameters, for calculation of these factors are meteorological data, which specifically characterize the atmospheric conditions for a certain location, as well as, for the long-term dispersion factors, the dispersion parameters, which describe the form of the waste air plume. The study considers the influence of meteorological statistics on the calculation of long-term dispersion and washout factors. In particular, it considers the deviations due to the use of the statistics for the whole year instead of the statistics for the summer period, with respect to the direct contamination of vegetation which is of significance to the dispersion of pollutants during the vegetation period. (orig./DG) With 11 figs. and tabs. in appendix.

40873 (ORNL/M–535) **Environmental surveillance data report for the fourth quarter of 1988.** Blasing, T.J.; Daniels, K.L.; Goldberg, P.Y.; Horwedel, B.M.; McCollough, I.L.; Morris, G.J.; O'Donnell, F.R.; Osborne-Lee, A.E.; Tardiff, M.F; Teeters, S.W. Oak Ridge National Lab., TN (USA). Jun 1989. 187p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE89015810/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The Environmental Monitoring and Compliance (EMC) Section within the Environmental and Health Protection Division (EHP) at the Oak Ridge National Laboratory (ORNL) is responsible for environmental surveillance to (1) ensure compliance with all federal, state, and Department of Energy (DOE) requirements for the prevention, control, and abatement of environmental pollution; (2) monitor the adequacy of containment and effluent controls; and (3) assess impacts of releases from ORNL facilities on the environment. The surveillance program for 1988 includes sampling and monitoring of air, water from surface streams and point sources, fish, milk, soil, and vegetation (grass) for radioactive and nonradioactive materials. This report includes data for air, surface water, groundwater, sediments, milk, fish, soil, and grass. Surveillance points are located on site to quantify discharges from ORNL facilities and off site to determine public exposures and to establish background reference levels. 23 figs., 93 tabs.

40874 (UCRL–99969-Rev.1) **Real-time regression schemes for integrating measurements with emergency response predictions: Revision 1.** Edwards, L.L.; Harvey, T.F.; Pitovranov, S.E. Lawrence Livermore National Lab., CA (USA). May 1989. 23p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8905115–3-Rev.1: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). Order Number DE89016634/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Atmospheric Release Advisory Capability (ARAC) of the US Department of Energy has initiated a program to establish the feasibility of incorporating an automated, real-time method of correcting predictions using radiological measurements acquired during an emergency. The Predictor/Corrector (P/C) Model is predicated on (1) being able to obtain real-time measurements, (2) having a sophisticated prediction model capable of running many times during an emergency response and, (3) using an appropriately designed non-linear regression scheme. Model sophistication will be designed as a function of available response time. The current plan is to use ARAC's MATHEW/ADPIC model as the P/C predictor, but with the model restructured with multiple loops to provide differing degrees of sophistication, to be invoked as response time allows. In this work, we study different regression schemes potentially appropriate for the Predictor/Corrector Model. We use the ARAC Instantaneous Point Source (IPS) model to predict observations that were made at the Savannah River Plant for SF_6 tracer releases during 1983. The number of IPS runs and the range of the initial parameter guesses that result in acceptable predictions are determined. Recommendations are made of the best candidates for implementation in the MATHEW/ADPIC model. 10 refs., 6 figs.

40875 **Room air monitor for radioactive aerosols.** Balmer, D.K.; Tyree, W.H. To Dept. of Energy, Washington, DC. USA Patent 4,820,925. 11 Apr 1989. Filed date 23 Mar 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A housing assembly for use with a room air monitor for simultaneous collection and counting of suspended particles includes a casing containing a combination detector-preamplifier system at one end, a filter system at the other end, and an air flow system consisting of an air inlet formed in the casing between the detector-preamplifier system and the filter system and an air passageway extending from the air inlet through the casing and out the end opposite the detector-preamplifier combination. The filter system collects suspended particles transported directly through the housing by means of the air flow system, and these articles are detected and examined for radioactivity by the detector-preamplifier combination.

5006 Regulations

40876 (CONF-8906140–3) **Overview of the regulation of hazardous chemicals: SDWA [Safe Drinking Water Act], RCRA [Resource Conservation and Recovery Act], and CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act].** Baes, C.F. III. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Health Physics Society summer school; Santa Fe, NM (USA); 19-23 Jun 1989. Order Number DE89015061/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The regulation of nonradioactive hazardous chemicals is carried out under a number of federal environmental laws that regulate either hazardous products, substances, or wastes. Because each law is intended to provide protection from different classes of substances (e.g., wastes vs products) or protect different media (e.g., air, water, land), the standards and levels of protection for different hazardous chemicals may be different. Nevertheless, one agency – the Environmental Protection Agency (EPA) – has primary responsibility for both promulgating regulations mandated by Congress under the various statutes and enforcement of the regulations. One overriding principal underlies the maze of complex regulations that govern the transport, treatment, storage, and disposal of hazardous substances: protect human health and the environment. It is beyond the scope of this talk to comprehensively examine all of the regulations and standards that govern the management of hazardous chemicals. Instead this discussion will focus on three statutes, the Safe Drinking Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), that together provide a basis for a basic understanding of the approach that the EPA takes to regulating hazardous chemicals.

40877 (SNV–3453) **Air pollution from vehicles in traffic.** National Swedish Environmental Protection Board, Solna (Sweden). 1988. 278p. (In Swedish). Order Number DE88755865/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The report discusses pollution control of vehicles in use that are covered by more stringent exhaust gas purification demands from models 1989 and onwards. In addition a system of spare part certification similar to the US system is discussed. (With 27 refs.) (O.S.).

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Refer also to citation(s) 40856

5101 Basic Studies

Refer also to citation(s) 40580

40878 (INIS-mf–11495, pp. 230-232) **Mathematical modelling of uranium transport in fractured crystalline rock.** Golian, C. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Nightingale, T. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Open system modelling will be applied to radiochemical data obtained by analysing the activity ratios of radioisotopes of the uranium series in rock and water samples to determine the timescale and dispersion rates in the given geological strata. The uranium ore deposits which are the subject of this modelling are being used as natural analogues of radioactive waste repositories.

5102 Chemicals Monitoring and Transport

Refer also to citation(s) 39846, 39947, 40021, 40908

40879 (CONF-890692–19) **Hazardous waste in the Pacific Basin: Assessing the risks.** Cirillo, R.R. Argonne National Lab., IL (USA). 1989. 16p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract W-31109-ENG-38. From 82. Air and Waste Management Association annual meeting and exhibition; Anaheim, CA (USA); 25-30 Jun 1989. Order Number DE89015065/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The region comprised of the basin and rim of the Pacific Ocean is experiencing a growing concern with the management of chemical hazardous waste. About 41% of the world's population live in this region. By very rough estimates, almost 272 million t of hazardous wastes are being generated every year in the same region. The economies of all of the countries, from the industrial giants to the tiny Pacific island nations, have already experienced the effects of improper treatment and disposal of hazardous wastes. To stimulate additional research on hazardous-waste management and to enhance the effectiveness of ongoing research efforts through international collaboration, the Pacific basin Consortium for Hazardous Waste Research was formed in the fall of 1986. The Consortium is a group of institutions that investigate methods of dealing with hazardous waste. The Consortium is not a government-to-government program. Rather, it is an assembly of research institutions that have chosen to work together to find needed answers to the technical questions involved in hazardous-waste management. This paper, prepared by the Pacific Basin Consortium Secretariat in conjunction with numerous institutional members and other organizations in the Pacific Basin, defines the scope of the hazardous-waste problem in the region and identifies issues common throughout the region. A country-by-country review of the hazardous waste issues is included. 5 refs., 4 figs., 2 tabs.

40880 (DOE/IG–0268) **Review of the environmental survey program.** USDOE Office of Inspector General, Washington, DC (USA). Capital Regional Office. 14 Jul 1989. 25p. Sponsored by U.S. DOE Management & Administration. Available from OSTI.

In 1985 the Department of Energy (DOE) initiated a program to perform environmental surveys of its operating facilities in response to increased concerns that toxic chemicals and radioactive contaminants were causing environmental damage in and around the facilities. The environmental survey program was designed to identify and prioritize environmental problems so that the Department could systematically decide on the order in which the problems should be addressed. The surveys began in June 1986 and were scheduled to take about 3 years to complete at an estimated cost of $60 million. The purpose of our review was to determine whether the surveys were accomplished in accordance with established criteria. Specifically, we evaluated whether (i) the environmental findings were documented according to established Departmental procedures, and (ii) whether management's decisions concerning categorization of environmental findings and sampling and analysis of potential contaminants complied with appropriate guidance.

40881 (RISO-M–2785) **Data aquisition and application of the programme system ECCES on forest soil.** Bille-Hansen, J.; Hovmand, M.F.; Brodersen, K.E. Risoe National Lab., Roskilde (Denmark). Feb 1989. 49p. (In Danish). Order Number DE89902325/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1 - Risoe Library, DK-4000 Roskilde.

EFP-87.

Preliminary developments are described for a project concerned with validation of the environmental effects modelling system ECCES as applied to forest soils. A description is given of two sites in Danish forest districts in Northern Zealand and Western Jutland, respectively, where a monitoring program comprising measurements of air pollution, dry and wet deposition, through-fall, litter fall and soil water composition have been in progress since 1985. The present project is a supplement to this main program. The project has two purposes: One is to include measurements on deposition and transport of heavy metals within the forest system, since the main program is only concerned with major components. Analyses of Cd, Zn, etc. in soil water samples and in samples of the soil itself have been made using ICP-MS technique. Unfortunately even this very sensitive method was not quite sufficient to obtain significant results for these unpolluted sites. The second purpose is to obtain additional soil data needed for the mathematical simulation of material fluxes in the forest and forest soil of major and minor components. Cation exchange capacities as functions of pH have been determined for four soil horizons at a typical site in the North Zealand forest. Distribution coefficents have been determined for the Cd/Ca system. Anion exchange capacities have been evaluated and found to be low. Modelling of the system have not yet been attempted, but a preliminary version of the ECCES system applicable to forests has been developed. The project is made as a cooperative effort between the Danish Forest Experiment Station, The Danish Environmental Research and Risoe National Laboratory. It is supported by grants from the Danish Ministry of Energy. (author).

5103 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 39970, 39973, 40027, 40032, 40044, 40049, 40053, 40054, 40673, 40868, 40873, 40878, 40917, 40960, 40961, 40971, 41261, 41264

40882 (BMU–1988-195) **Deposition and washout of radioactive material on vegetation and soil.** Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. Horn, H.G.; Maqua, M.; Bonka, H. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Forschungsgebiet Strahlenschutz in der Kerntechnik. 20 Mar 1988. 258p. (In German). Contract BMU St.Sch. 00920. Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Washout coefficients, rates of deposition and a retention factor are given for tritium, radioactive iodine and radionuclides bound to aerosol particles. Calculation methods are developed. For clarifying some effects, which have been difficult to record so far, experiments are carried out and prepared. The measurements after the accident of Tchernobyl permitted the control of the data. For radionuclides released from nuclear facilities in normal operation and which are bound to aerosol particles, a medium washout coefficient of $\approx 7 \times 10^{-5}$/s $(I/I_0)^{0.8}$ and a medium rate of deposition for meadows of 0.15 cm/s should be used. The washout coefficient of elementary iodine is not higher than that of the aerosol particles. The washout coefficient of HTO and HT should be at 4×10^{-5}/s (I/I_0). For the calculation of the mean deposition of elementary iodine on grass, it is sufficiently conservative to assume a rate of deposition of 1 cm/s. For the retention factor of grass, a value of 0.3 should be used. The

models used today permit the application of the same rate of deposition and retention factor for grass and plants, as the translocation of the radionuclides into the edible part of the plant is not taken into account. (orig./HP).

40883 (CONF-890854–2) **Field testing and applications of the Ultrasonic Ranging and Data (USRAD) System.** Dickerson, K.S.; Pickering, D.A.; Blair, M.S.; Espegren, M.L.; Nyquist, J.E. Oak Ridge National Lab., TN (USA). 1989. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. From 11. annual DOE low level waste management conference; Pittsburgh, PA (USA); 22-24 Aug 1989. Order Number DE89014760/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Ultrasonic Ranging and Data (USRAD) System is a patented, computerized data acquisition system developed to relate the radiological surveyor's precise physical location to instantaneous radiation data taken during walk-on surveys. The USRAD System incorporates three technologies: radio frequency communications, ultrasonics, and microcomputers. Initial field testing of the USRAD System has resulted in several improvements to walk-on radiological surveys including real-time position data, reproducible survey results, on-site verification of survey coverage, on-site data reduction and graphics, and permanent data storage on magnetic media. Although the USRAD System was developed specifically for use with a gamma-ray detector, it is adaptable to other instruments. Applications of the USRAD System may include verification of remediated and uncontaminated areas, emergency response in mapping pollutant locations after accidents, and characterization of hazardous waste areas. 2 refs., 8 figs.

40884 (EGG–10617-1004) **An aerial radiological survey of the South Texas Project Electric Generating Station and surrounding area, Bay City, Texas: Date of survey: March–April 1988.** Thompson, J.M. EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab. Dec 1988. 13p. Sponsored by DOE/NE;NRC. DOE Contract AC08-88NV10617. Order Number DE89014330/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An aerial radiological survey was conducted over the South Texas Project Electric Generating Station (STPEGS) near Bay City, Texas, during the period 25 March to 4 April 1988. The purpose of the 259-square-kilometer (100-square-mile) survey was to document the terrestrial gamma environment of the plant and surrounding area. An exposure rate contour map at 1 meter above ground level (AGL) was constructed from the gamma data and overlaid on an aerial photograph and map of the area. Exposure rates were observed up to 10μR/h over land. No areas of enhanced exposure rates were observed. Ground-based exposure rate measurements and soil samples were obtained to support the aerial data. Oblique aerial photographs of the plant were also acquired during the survey. 9 refs., 4 figs., 1 tab.

40885 (INIS-mf–11502, pp. 27-32) **Estimation of radiation exposure to the population of Arad, following the opening of the 'Sedeh-Zohar' phosphate mine.** Talmor, A. (Israel Atomic Energy Commission, Beersheba (Israe!). Nuclear Research Center-Negev); Laichter, Y.; Weiser, G. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

During a national survey of rock phosphate deposits in 1981, a large and rich field was discovered in the vicinity of Arad. This new deposit, known as 'Sedeh-Zohar', is spread over an area of some 100 km^2 and has been estimated to contain about 200 million tons of high quality raw material. At the request of Negev Phosphate Ltd., an estimation of the radiation exposure dose to the population of Arad, was undertaken. Rock phosphates in the Negev contain several naturally occuring radioisotopes, mainly uranium (about 150 ppm) and traces of thorium and potassium. The mining operations of these phosphate deposits and their subsequent industrial use will no dout lead to the release of radioactivity into the atmosphere, and some of it may reach the city of Arad. The average annual exposure dose from natural radioactivity has been estimated as 2mSv (200 mrem/y). It was found that the natural background radiation in Arad is at least as high as the overall world average values of 2000 μSv/y (200 mrem/y), which includes all possible external and internal exposures. The overall addition of 70 μSv/y (7 mrem/y) to the population of Arad, due to the operation of the mining facility at Sede-Zohar, would constitute only about 3.5% more background radiation, within the range of regional fluctuations in the natural background.

40886 (INIS-mf–11502, pp. 23-26) **Radon-222 levels in northern Israel during summer 1987.** Margaliot, M. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Schlesinger, T.; Even, O.; Israeli, M. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40887 (LA–11487-T) **The comparative uptake and interaction of several radionuclides in the trophic levels surrounding the Los Alamos Meson Physics Facility (LAMPF) waste water ponds.** Brooks, G.H. Jr. Los Alamos National Lab., NM (USA). Aug 1989. 151p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89015751/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Thesis. Submitted to San Jose State Univ., CA.

A study was undertaken to examine the uptake, distribution, and interaction of five activation products (Co-57, Be-7, Cs-134, Rb-83, and Mn-54) within the biotic and abiotic components surrounding the waste treatment lagoons of the Los Alamos Meson Physics Facility (LAMPF). The study attempted to ascertain where, and what specific interactions were taking place among the isotopes and the biotic/abiotic components. A statistical approach, utilizing Multivariate Analysis of Variance (MANOVA), was conducted testing the radioisotopic concentrations by (1) the trophic levels (TROPLVL) in each position sampled on the grid, (2) where sampled on the grid (TRAN), (3) where sampled with-in each grid line (PLOT), and (4) the side with which sampled (SIDE). This provided both the dependent and independent variables that would be tested. The Null Hypothesis (Ho) tested the difference in the mean values of the isotopes within/between each of the four independent variables. The Rb-83 statistic indicated an accumulation within the TRAN and PLOT variables within the sampled area. The Co-57 test statistic provided a value which indicated that accumulation of this isotope within TROPLVL was taking place. Mn-54 test values indicated that accumulation was also taking place at the higher trophic levels within the PLOT, TRAN, and SIDE positions. Cs-134 was found to accumulate to third level in this trophic level structure [TROPLVL-(vegetation)], and then decrease from there. The Be-7 component provided no variance from known compartmental transfers. 210 refs., 17 figs., 4 tabs.

40888 (OEFZS–4489, pp. 1-14) **Wheat radioactive contamination in the Italian territory with particular reference to the province of Piacenza as a consequence of the Chernobyl accident.** Carini, F. (UCSC, Agricultural Faculty, Chemistry Institute, Piacenza (Italy)); Botteschi, G.; Silva, S. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

From radiocesium analyses on several samples of wheat from all over Italy, it can be stated that this species was one of the most widely affected by the radioactive fallout with an average value, referred to Cs-137 and Cs-134, of 196 Bq/kg f.w.. The radioactivity distribution on the basis of the altimetric factor shows a greater radiocaesium absorption at lower altitudes as compared with the medium and above all the higher ones. These results are to be attributed to the different vegetation stage of the wheat at the moment of contamination, as a consequence of a climate difference due to altimetry. The radioactivity differences observed in the various cultivars are imputable to climate factors again, rather than to genetic ones. No correlation was observed between absorbed radiocaesium

and contents of assimilable potassium of the soil. 8 refs., 5 figs., 2 tabs.

40889 (OEFZS–4489, pp. 34-52) **Contamination of food in the first and second year after the Chernobyl accident and its derived dose to the Austrian population.** Mueck, K. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Inst. fuer Strahlenschutz). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The variation with time of the activity concentration in various food items in Austria after the Chernobyl accident is given. In particular, first and second year activity concentrations of ^{137}Cs are compared. With an average level in the first year of 45 Bq/kg in milk, 73 Bq/kg in meat and 15 Bq/kg in cereals the activity concentrations in the second year decreased in milk and meat to 20%, in cereals to 4% and in fruit to 18% of the first year levels. Compared to the concentrations just after the accident a decrease to levels of less than 9% was observed in these food items. Measurement of the ^{90}Sr-activity concentrations showed no increase comparable to that of ^{137}Cs. On the contrary, it is shown that the intake of ^{90}Sr and the resulting dose are dominated by radiostrontium from the atomic weapons testing even after the Chernobyl accident. From these activity concentrations and the average food consumption the ingested activity of ^{131}I, ^{134}Cs, ^{137}Cs and ^{90}Sr is estimated. The dose resulting from the intake of these radionuclides amounts to: 1. year: ^{131}I: 0,029 mSv; ^{134}Cs+^{137}Cs: 0,419 mSv; ^{90}Sr: 0,006 mSv; 2. year: ^{134}Cs+^{137}Cs: 0,079 mSv; ^{90}Sr: 0,004 mSv. 9 refs., 12 figs., 4 tabs.

40890 (OEFZS–4489, pp. 87-97) **Studies on the migration of ^{137}Cs from the reactor accident of Chernobyl in soils in the region of Hamburg.** Becker-Heidmann, P. (Hamburg Univ. (Germany, F.R.)); Bauske, B.; Scharpenseel, H.W. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

In the region of Hamburg 30 soil profiles have been sampled layerwise and measured by gamma spectrometry. The sites comprise forest as well as agricultural soils, different soil orders and texture. From the results for ^{137}Cs and ^{134}Cs the deposition by the Chernobyl fallout and by the atom bomb tests of the fifties are calculated. The recent deposition of ^{137}Cs is between 1300 and 6300 Bqm^{-2}. The maximum of initial penetration of the isotopes into the soil was 15 cm. Few results of a later sampling indicate translocation processes. The possible reasons for the large variations of the results are discussed. For comparability of results between different laboratories a uniform sampling is recommended. The advantages of layerwise sampling are discussed. Dose calculations amount to a maximum of 15 mSv accumulated over the next 50 years due to external irradiation of ^{137}Cs and ^{134}Cs from the soil surface only. A more realistic estimation gives 0,3 to 0,7 mSv for adults and 0,7 to 1 mSv for pre-school children. 9 refs., 2 figs., 3 tabs.

40891 (OEFZS–4489, pp. 15-26) **Levels of ^{137}Cs in Sweden 1986-87.** Mascanzoni, D. (Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Radioecology). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

After the Chernobyl accident, substantial amounts of radioactive materials were transported to Sweden and detected both in the atmosphere and deposited on the ground. The insertion and subsequent accumulation of radioactive substances in the ecosystem poses particular concern for the food chain. An extensive program of measurements was started by the National Food Administration in cooperation with our department to determine the levels of radionuclides in the environment, particularly in the food chain. The primary aim of the monitoring was to obtain a detailed survey of contents of ^{137}Cs in a wide variety of foodstuffs, including vegetables, fruits, edible wild plants, dairy products, fish, wild and tame animals. The results reported here cover the period 1986-87 and describe the ^{137}Cs levels in the most contaminated areas. 15 refs., 4 figs., 6 tabs.

40892 (OEFZS–4489, pp. 53-86) **Contamination of game in Austria after the Chernobyl accident.** Schoenhofer, F. (Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria)); Tataruch, F. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

Game is known to be a very sensitive bioindicator for contamination with I-131 and especially Cs-137. So after the Chernobyl accident and the extensive contamination of Austrian territory almost immediately a surveillance programme on game was started. By these investigations several aims were achieved simultaneously: the geographical distribution of contamination was confirmed and even some unknown critical regions were found additionally. The contamination of game was checked and its dependency on region and time could be used for prognoses and decisions on prohibition of shooting and regarding consumption of game. As a byproduct many parameters could be investigated influencing the contamination of game - e.g. species of animal, dependency on time, age habitat as well as on feeding habits. The special case of large forests where extremely high values were found in game, even rising in autumn 1987, is discussed. Some factors influencing the contamination of game will be discussed. It is concluded from the complexity of natural systems that it is impossible to derive any transfer factors even from a lot of contamination measurement data and use them for quantitative prognosis of contamination. Each prediction can only be on the basis of a qualitative or less than semiquantitative estimation. Measurements of actual contamination levels cannot be replaced by calculations if maximum concentration levels are set by the authorities. The measures taken by the Austrian authorities regarding game are explained. 10 refs., 16 figs., 2 tabs.

40893 (OEFZS–4489, pp. 98-112) **Investigations on the role of soil organic components in the sorption of radioiodine.** Bors, J. (Niedersaechsisches Inst. fuer Radiooekologie, Hannover (Germany, F.R.)); Martens, R. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

A batch experiment with I-125 revealed the general tendency of increasing distribution coefficients (K_d-values) with increasing organic C-content of different horizons of a chernozem and a podzolic soil profile. Experiments with different incubation conditions as insterile (aerobic and anaerobic), sterile and different incubation temperatures as well as with biologically relevant soil properties (water content, storage conditions) delivered indications for the participation of soil microflora in iodine immobilization. However, no occurence of a temperature optimum of the kinetic of the sorption was observed indicating that physicochemical processes are also involved in iodine immobilization. Experiments with artificially increased or decreased biomass showed a good correlation between biomass content and K_d-values emphasizing the important role of microorganisms in iodine fixation. As a further proof of microbial effects on iodine immobilization incorporation of radioiodine was tested with pure cultures of bacteria and fungi isolated from the soil. A considerable uptake of radioiodine was found in washed (NaCl, $CaCl_2$) cells with both bacteria and fungi, but no incorporation was detected into cells incubated with radioiodine in the culture medium. This may be explained by the formation of nonavailable complexes

of iodine with components of the medium and/or with cell exudates. 9 refs., 3 figs., 4 tabs.

40894 (OEFZS–4489, pp. 27-33) **Contents of radiocesium - 137 and radiostrontium - 90 in broiler nutrients rich in soy.** Micic, G. (Veterinary Faculty, Dept. of Radiology and Radiation Hygiene, Belgrade (Yugoslavia)); Draganovic, B.; Benderac, R.; Ristic, D. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The contents of radiocaesium and radiostrontium in broiler nutrients containing soy up to 17-24%, were investigated during 1985, and during a period of time after the Chernobyl accident (1986-87). The research was extended to investigation of contents of radiocaesium 137 and radiostrontium 90 and the changes in their concentration in the same kind of nutrients. In that way, we obtained the data about the increasing of the irradiation risk for fast fattening poultry if the soy rich nutrients are used. 7 refs., 2 figs., 1 tab.

40895 (OEFZS–4489, pp. 134-142) **Depth distribution of radiocaesium in agricultural soils in Chernobyl fallout areas of Sweden in 1987-88.** Loensjoe, H. (Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Radioecology). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The effects of a farm land contamination with long-lived radioactive fallout will to a great extent depend on how the nuclides eventually will be distributed in the soil profile. The depth distribution thus will influence the root uptake of as well radiocaesium (134-Cs and 137-Cs) as radiostrontium (mainly 90-Sr), and furthermore the external exposure (by the gamma radiation from 134+137-Cs) to people living in the contaminated area. In this paper data are presented on the depth distribution of radiocaesium in agricultural soils in the most contaminated areas of Sweden after the Chernobyl accident in April 1986. Most of the sampling was performed in the autumn of 1987, i.e. about 18 months after the deposition. 4 refs., 2 figs., 1 tab.

40896 (OEFZS–4489, pp. 143-156) **Activity in local batches of soil layers.** Meisel, S. (Technische Univ., Graz (Austria). Reaktorinstitut); Graller, P.; Kahr, G.; Ninaus, W.; Mueller, H. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

Each time in the late summer since 1986 we collected until now about 1500 soil samples a 2-4 kg at 17 locations in Styria and evaluated them with a gamma HPGe spectroscopy system. The large amount of samples results from the accurate technique of sampling developed by us. The defined position of the soil layers makes it possible to get the density and the humidity of each soil layer at sampling time, in addition to the deep distribution of the gamma emitting radionuclides with a comparable confidence. The bad deviations of local distributions are compensated by large area samples (4x0,2 sqm) of four respective adjacent layer series, which were taken normally in cm - steps down to a depth of 60 cm. Our supplementary investigations to the inhomogenity of the activity distribution within a soil layer would explain the divergency of transfer factors for simulations true to nature given in literature. 10 refs., 12 figs., 1 tab.

40897 (OEFZS–4489, pp. 113-118) **Leaching of Co-60 and Cs-134 from the rooting zone of an experimental field.** Fagniart, E. (SCK-CEN, Dept. of Radioprotection, Mol (Belgium)); Colard, J.; Kirchmann, R. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

In 1982 sandy soils of several experimental plots were contaminated homogeneously (20 cm layer) with ^{134}Cs and ^{60}Co, to study, on the one hand the transfer factors from soil to plant (ageing effect on the transfer) and on the other hand the leaching of these radionuclides from the rooting-zone in field conditions. By the mean of a draining- and a pumpsystem the leached water has been collected and the concentration of the two radionuclides measured by gamma spectrometry. The results obtained with ^{134}Cs in 1985 and 1986 show that the percentage of radioactivity leached from the soil is very low: respectively $0,08\pm0,03$ and $0,07\pm0,05$. In the case of ^{60}Co the percentage of leaching is generally higher by an order of magnitude than for ^{134}Cs. Results of leaching obtained in 1987 will also be presented. 2 figs., 1 tab.

40898 (OEFZS–4489, pp. 119-133) **Comparison of laboratory and field studies determining the deposition velocities of elementary tritium.** Foerstel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Radioagronomie). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The deposition velocity is a useful parameter to characterize the flux of a gaseous compound from the air into the soil. After collecting small soil cores in the field, the deposition velocity of these samples can be easily determined in a laboratory set up. Elementary tritium is injected into a well-mixed air circuit which is in contact to the surface of a soil core. The deposition velocity can be calculated from the decrease of the tritium concentration in the air, measured continuously by an ionisation chamber. The applicability of this laboratory method to predictions or to modelling was confirmed by two release experiments carried out under field conditions. Both on a French and on a Canadian site elementary tritium was released into a natural ecosystem. The deposition velocities were calculated from the tritium concentration in the air and the resulting tritium water content in the soil after its contact with the release plume. Deposition velocities of the cores from these sites, which were separately measured in the laboratory set up, showed the same numerical values as calculated from the field data. The most important radioecological pathway of tritium is the enzymatically catalyzed oxidation of the elementary tritium gas in the upper centimeters of the soil and the subsequent release of the oxidation product (tritiated water) back from the soil into the air, the so-called reemission. After the oxidation of elementary tritium to tritiated water the radioecological pathway of tritium is dominated by the water fluxes in the local ecosystem (movement in the soil, transport in the plant). 9 refs., 7 figs., 4 tabs.

40899 (OEFZS–4489, pp. 182-195) **Use of Chernobyl field data in modelling cesium transfer to grassland crops.** Eriksson, A. (Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Radioecology). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The fallout of radioactivity released from Chernobyl in Apr 1986 contaminated vast areas of Sweden. Beside control surveys also studies on the transfer rate of cesium to the grassland hay crops were carried out on a number of farms. A large variation was found in the transfer of cesium. To shed more light on the reasons for the variations observed a more detailed study was undertaken at certain contaminated field experimental sites in grassland crops. 1 ref., 3 figs., 5 tabs.

40900 (OEFZS–4489, pp. 196-208) **Cs-137 transfer into plants from contaminated Austrian soils.** Gerzabek, M.H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Inst. fuer Landwirtschaft); Ullah, S.M.; Mueck, K. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

In Austria, the activity deposit per square meter due to the Chernobyl reactor accident ranges between 740 Bq in the northeastern part of Lower Austria and 90761 Bq in Upper Austria. The resulting high Cs-137 concentrations in the Austrian soils make soil to plant transfer studies desireable. Another question, the present work deals with, is to see the influence of K-, Mg- and NH_4NO_3-applications on the Cs plant uptake. Pot experiments with two contaminated brown soils and a chernozem were conducted. The following mean Cs- transfer factors (FW/DW) were obtained: barley (grains: 0,00094; straw: 0,009), corn (grains: 0,0028; straw: 0,0057), rye (grains: 0,020; straw: 0,048) and endive (0,0028). The transfer factors were hardly influenced by potassium- and magnesium- applications, due to the high clay contents of the soils and the adequate autochthonous supply with potassium and magnesium. NH_4NO_3- treatments increased the Cs-uptake into rye (grains and straw) distinctly. 13 refs., 3 figs., 4 tabs.

40901 (OEFZS–4489, pp. 257-273) **Radiosilver ^{110m}Ag from Chernobyl and its transfer from plant to ruminants.** Pfau, A.A. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.)); Fischer, R.; Heinrich, H.C.; Handl, J. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

Radiosilver ^{110m}Ag from Chernobyl fallout was measured by γ-spectroscopy with a HP-Ge detector in first cut hay from 1986 with a ^{110m}Ag/^{137}Cs ratio of 0.002 and with increasing ratios in livers of mouse, sheep and cattle varying from 0.04 to 1.7. No detectible radiosilver was found in livers of roe deers and humans. Besides ^{110m}Ag and naturally occuring ^{40}K typical radionuclides like ^{90}Sr, ^{131}I, ^{134}Cs and ^{137}Cs and less common ^{129m}Te were observed in mammalian tissues only. In an indoor experiment the hay to liver transfer coefficient for ^{110m}Ag was determined as 1.5 d/kg in 3 sheep. This transfer experiment was analyzed by means of a one-compartment model. The speculations about the origin of the Silver in the Chernobyl fallout were discussed on the basis of experimental findings. 39 refs., 4 figs., 2 tabs.

40902 (OEFZS–4489, pp. 209-221) **Cs-137 uptake and transfer as a function of the properties of 17 soils.** Kerpen, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Radioagronomie). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

^{137}Cs biotest experiments were carried out with 17 soils of the FRG. They include soils of rather different origins and geneses with a widely varying properties. The experiments were accomplished in small pots with 500 g of soil under standardized glasshouse conditions using spring wheat and spring barley. The ^{137}Cs uptake by the two cereals and the transfer factors vary greatly, namely in a range of 10^3. It will be shown that ^{137}Cs uptake as well as ^{137}Cs transfer factors of wheat and of barley are functions of the soil. 2 refs., 13 figs.

40903 (OEFZS–4489, pp. 230-235) **Availability of deposited ^{137}Cs to man.** Frissel, M.J. (Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands)); Mattern, F.C.M.; Drost, R.M.S.; Keverling Buisman, A.S.; Stoute, J.R.D. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

Since the accident in Chernobyl the ECN at Petten determines monthly the ^{134}Cs and ^{137}Cs concentrations in a representative group of people in the North Western part of the Netherlands, while at RIVM the average ^{134}Cs and ^{137}Cs concentrations in milk of the Netherlands are determined. From a comparison of the calculated ^{137}Cs burden of men and the observed burden it can be concluded that the models, as used at RIVM, represent equilibrium system quite well. When applied to dynamic systems the models take unsufficiently into account the delays which exist in the food chain. The ^{134}Cs/^{137}Cs ratios, both in milk and man, appeared to be until October 1987 close to a source term ratio of 0.5 at May 2, 1986. This indicates that for the whole period the Cs in the biosphere results from the recent deposition. From earlier investigations by RIVM it is known that the upper 20 cm of the soil contain 1500 Bq ^{137}Cs per m^2, resulting from atomic bomb test series while Chernobyl caused concentrations of 920 Bq ^{134}Cs per m^2 and 1800 Bq ^{137}Cs per m^2. When both Cs isotopes would have been available to the same extent much lower ^{134}Cs/^{137}Cs ratios would have been found. Even at the end of 1987 the influence of the earlier deposited ^{137}Cs is not yet appearent, one has to conclude that the availablility of the old Cs is much lower than of the recent deposited Cs. Extrapolation of present data shows that the uptake from early ^{137}Cs fall out may be reduced to 10 percent indeed. 1 refs., 3 figs.

40904 (ORNL/RASA–88/66) **Results of the radiological survey at Interstate 80, North Right of Way at Lodi Brook, Lodi, New Jersey (LJ077).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Jun 1989. 13p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015072/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and oil sampling for radionuclide analyses. The survey of this site, on the North Right of Way of Interstate 80 at Lodi Brook, Lodi, New Jersey (LJ077), was conducted during 1988. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 5 refs., 3 figs., 3 tabs.

40905 (ORNL/RASA–88/67) **Results of the radiological survey at 90 C Avenue, Lodi, New Jersey (LJ079).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Jun 1989. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015823/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards.

Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducted an investigative radiological survey during 1988 at 90 C Avenue, Lodi, New Jersey (LJ079), one of the properties in the vicinity of the MCW site. The survey included a gamma radiation scan of the surface and at one meter above the surface, as well as radionuclide sampling of surface and subsurface soil. The survey objective was to determine whether this site was contaminated with radioactive residues derived from MCW, principally ^{232}Th. Results of the survey demonstrated radionuclide concentrations in excess of DOE remedial action criteria, primarily from the ^{232}Th decay chain, with some contamination from ^{226}Ra. The radionuclide distributions are typical of the type of material originating from the MCW site. 5 refs., 3 figs., 3 tabs.

40906 (ORNL/RASA–88/68) **Results of the radiological survey at 62 Trudy Drive, Lodi, New Jersey (LJ080).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Jun 1989. 13p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015080/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 62 Trudy Drive, Lodi, New Jersey (LJ080), was conducted during 1988. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 5 refs., 5 figs., 3 tabs.

40907 (ORNL/RASA–88/72) **Results of the radiological survey at 108 Avenue E, Lodi, New Jersey (LJ084).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Jun 1989. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015081/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 108 Avenue E, Lodi, New Jersey (LJ084), was conducted during 1988. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 5 refs., 2 figs., 2 tabs.

5105 Site Resource and Use Studies

Refer also to citation(s) 40025, 40043, 40075, 40884

40908 (ANL/EES-TM–374) **Results of the decontamination survey of the nickel carbonyl plant at the Redstone Arsenal, Huntsville, Alabama.** Biang, R.P.; Wilkins, B.D. Argonne National Lab., IL (USA). Energy and Environmental Systems Div. Apr 1989. 14p. Sponsored by U.S. Department of Defense. DOE Contract W-31109-ENG-38. Order Number DE89015114/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report presents the results of a decontamination survey of the nickel carbonyl plant at the Redstone Arsenal in Alabama. A total of 12 air samples (taken with Draeger tubes) and 22 wipe samples were taken from various plant locations. Immediate analysis of the air samples revealed no significant contamination with nickel carbonyl, and laboratory analysis of the wipe samples revealed only low nickel concentrations. These results show that dismantlement of the plant poses minimal risk to human health or the environment; however, personnel need protective equipment while handling the asbestos insulation present in the plant. 5 refs., 2 figs., 3 tabs.

5106 Regulations

Refer also to citation(s) 40876

52 ENVIRONMENTAL SCIENCES, AQUATIC

Refer also to citation(s) 40856

5201 Basic Studies

Refer also to citation(s) 40917

40909 (CRIE–U-88010) **Development of the techniques for marine macrophyte bed creation (Part 9). Underwater irradiance and depth limit for the eelgrass bed creation.** Ishikawa, Yusuke; Kawasaki, Yasuo; Honda, Masaki; Maruyama Yasuki; Igarashi, Yoshio. Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). Bio-Environment Lab. Sep 1988. 20p. (In Japanese). Order Number DE89772379/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst., of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan.

A depth distribution survey of eelgrass and an on-the spot investigation on underwater irradiance were carried out. There was no difference in the growth rates of leaves of eelgrass transplanted to various depths when the underwater irradiance was approximately more than 3E/m^2/d. Using data of the depth distribution of eelgrass and the turbidity of sea areas, the minimum light requirement for eelgrass growth was estimated. It was estimated that eelgrass growth can be observed in the area where the annual average underwater irradiance is more than 3E/m^2/d, but more than 4E/m^2/d is required for eelgrass to grow thick. To determine the depth limit for eelgrass bed creation, it is necessary to learn the depth which gives a certain underwater irradiance as a function of solar irradiance and seawater turbidity indices. A simple simulation technique using simple language (spread sheet software) is proved to have the ability of performing these computations. 19 references, 7 figures, 6 tables.

40910 (SNV–3549) **Ecological effects of winter reed-harvest 1977-1987 in lake Taakern.** Lundqvist, M.; Svedlindh, C.; Landin, J.; Ekstam, B. National Swedish Environmental Protection Board, Solna (Sweden). Nov 1988. 43p. (In Swedish). Order Number DE89902398/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Ecological effects of winter reed-harvest were studied during 1981-1983 and winter - early summer 1987 in lake Taakern, a shallow eutrophic lake in the south of Sweden. A harvested reed stand was compared with an unharvested one. In summary, due to climatological differences spring seems to occur two or three weeks earlier in harvested reed stands than in unharvested ones. Ecological differences are larger during spring than during later seasons.

40911 (TR-EL–82-4) **Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic): Bluefish.** Oliver, J.D.; Van Den Avyle, M.J.; Bozeman, E.L. Jr. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA); Fish and Wildlife Service, Washington, DC

(USA); Georgia Univ., Athens, GA (USA). School of Forest Resources. Apr 1989. 20p. (BR–82(11.96)). Available from U.S. Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458 - OSTI.

Species profiles are literature summaries of the life history, distribution, and environmental requirements of coastal fishes and invertebrates. Profiles are prepared to assist with environmental impact assessment. The bluefish (Pomatomus saltatrix) is a valuable recreational and commercial fish on the Atlantic coast. In the South Atlantic Region the recreational catch exceeds the commercial catch. The bluefish is a migratory pelagic fish that generally travels northward in spring and summer and southward in fall and winter along the Atlantic seaboard. In the South Atlantic Region, spawning occurs primarily during spring waters just shoreward of the Gulf Stream form southern North Carolina to Florida. Most larvae are carried northward by the Gulf Stream and are dispersed over the continental slope of the Middle Atlantic Region. Adult bluefish inhabit nearshore areas in the South Atlantic Region during their southerly migration in fall and winter. Larval bluefish eat mostly copepods, cladocerans, and invertebrate eggs; juveniles eat larger invertebrates and fishes. Adult bluefish eat fishes and seem to prefer schooling coastal species. Bluefish have been reported to avoid areas of low dissolved oxygen. Water turbidity may affect feeding because bluefish rely on vision to locate prey. Environmental disturbances which affect the dissolved oxygen concentration or turbidity of estuarine and nearshore waters may, therefore, affect bluefish distribution and feeding. 40 refs., 4 figs., 2 tabs.

5202 Chemicals Monitoring and Transport

Refer also to citation(s) 39803, 39947, 39979, 40114, 40879

40912 (AL-ESRF–090) **Analysis of sediment data from the Beaufort Sea shorebase monitoring program, 1982 to 1984.** Wainwright, P.F.; Humphrey, B. Arctic Labs. Ltd., Sidney, BC (Canada). 1988. 157p. (MICROLOG–89-00753). Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, Canada K1A 0E4; $20-50 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Data analysis and interpretation are presented from the chemical analysis of Beaufort Sea sediments collected from 1982 to 1984. The entire data set was examined to identify means to permit simplification of the analysis. The approach adopted was to assume that the data belonged to a single population, which was then characterized and examined for deviating observations or outliers. Preliminary analyses demonstrated that the concentrations of contaminants of interest were determined primarily by the grain size of the sediment collected. Therefore, statistical analysis was restricted to observations with concurrent grain size results. Relationships between contaminant concentrations and grain size were then determined and the residual values from the contaminant/grain size regression relations were analysed. Samples with contaminant concentrations in excess of the value predicted by the grain size relations plus a 99% prediction interval were then identified. Maps of outliers were plotted for each contaminant. Inspection of the resulting maps clearly identifies an association of outlier sites and industrial activity. Many of the outliers identified are associated with loading docks or sites of dredging activity. The environmental significance of anthropogenic inputs was assessed by determining an index of contamination, which was mapped in the same way as the contaminant outliers. The maps of contaminant deviations and index of contamination were sufficient to identify and interpret areas of risk. Outliers were found primarily in Tuktoyaktuk Harbour and McKinley Bay. The outliers in different locations included different contaminants. 18 refs., 95 figs., 8 tabs.

40913 (CONF-8902125–1) **Report on working group deliberations, water quality group, Second regional workshop on integrated monitoring.** Wesely, M.L. Argonne National Lab., IL (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 2. regional workshop on integrated monitoring; Burlington, VT (USA); 6-8 Feb 1989. Order Number DE89015700/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Environmental monitoring data on water quality and aquatic biota are necessary to evaluate the spatial distribution and temporal trends of pollutants, identify their sources, and evaluate effects. In addition, an efficient method of making data readily available to users is needed. For the transboundary region near the border between the Province of Quebec and the States of New York and Vermont, lake acidification is a prominent concern that poses difficult questions with regard to long-term trends, the relative importance of anthropogenic and natural sources of change, and methods of remediation. Other recurring concerns include the effects of municipal, agricultural, and industrial sources of contamination on the quality of drinking water, on the uses of surface waters for recreational purposes, and on the preservation of ecosystems. For the purposes of both research and regulation, background levels of pollutants and the natural state of water quality ideally should be determined. In this transboundary region as in others, however, changes in aquatic environments often occur before adequate monitoring begins.

40914 (GKSS–88/E/64) **Laboratory experiments as to the flocculation and settling velocity of suspended matter in the river Elbe.** Kluender, A. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 1988. 97p. (In German). Order Number DE89794919/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01.

Part A describes laboratory experiments to verify the influence of water salinity on flocculation of suspended matter depending on its content of organic substances. Therefore the settling velocity of suspended matter flocs is measured in a 5 m settling column under various conditions. The results show that flocculation depends mostly on the content of organic substances in suspended matter and the influence of the water salinity is very small. In part B tests were carried out on a new settling column with artificial turbulence to show the possibilities of simulating natural conditions in the laboratory: the results were positive. (orig.) With 26 figs., 1 tab.

40915 (PNL-SA–16731) **An integrated enviromental monitoring program at a US Nuclear Research Facility.** Gray, R.H. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8906173–1: International symposium on integrated approaches to water pollution problems, Lisbon (Portugal), 19-23 Jun 1989). Order Number DE89014924/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Water quality issues are key components of a comprehensive environmental monitoring and surveillance program. In addition to monitoring radioactivity and chemicals in surface and ground water, the program monitors air, foodstuffs, wildlife, soil and natural vegetation. Population numbers of key wildlife species are also determined, usually during the breeding season. In 1987, measured Hanford Site perimeter concentrations of airborne radionuclides were below applicable guidelines. Tritium and nitrate continued to be the most widespread constituents in onsite ground water. Chromium, cyanide, fluoride, and carbon tetrachloride were found in ground-water wells near operating areas. Concentrations of radionuclides identified at a municipal water intake on the Columbia River were below limits established for drinking water. Foodstuffs irrigated with river water taken downstream of the site showed low levels of radionuclides that were similar to concentrations found in foodstuffs not irrigated with Columbia River water. Low levels of ^{90}Sr and ^{137}Cs found in some onsite wildlife samples were typical of those attributable to worldwide fallout as were the low concentrations of radionuclides found in soils and vegetation from both onsite and offsite locations. 29 refs., 4 figs.

40916 (WHC-SA–0174) **Evaluation of sampling equipment for RCRA [Resource Conservation and Recovery Act] monitoring in a deep unconfined aquifer.** Kasper, R.B.; Serkowski, J.A. Westinghouse Hanford Co., Richland, WA (USA). Feb 1988. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-8805312–1: 2. national outdoor action conference on aquifer restoration, groundwater monitoring and geophysical methods, Las Vegas, NV (USA), 23-26 May 1988). Order Number DE89014947/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Acceptable sampling devices identified include gas-operated bladder pumps and bailers constructed of nonreactive materials. In arid portions of the western United States, depths to ground water, which are often greater than 100 feet, make the use of bailers extremely time consuming. The efficiency of gas-operated bladder pumps decreases with depth, and special design and construction is often needed to accommodate higher gas pressures. Commercially available sampling pumps were evaluated for their suitability as sampling and purging equipment for installation in monitoring wells in a deep, unconfined aquifer. The test was conducted in a well where the depth to ground water was 340 feet. The objective was to identify equipment capable of discharge rates suitable for sampling (~0.025 gpm) and, if possible, for purging (>1 gpm). The potential for physical or chemical alteration of the water sample was evaluated from literature sources and not specifically tested. Four positive-displacement pumps were tested, consisting of two bladder pumps, a gas-driven piston pump, and a mechanically-driven pump. All pumps could be installed in a 2-inch diameter well, although this was not important for the planned application. 4 refs., 1 tab.

5203 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 39979, 40008, 40028, 40044, 40049, 40054, 40259, 40873, 40887, 40915, 40960, 41059

40917 (ANL–88-31, pp. 59, Paper 2) **Environmental effects research program.** Argonne National Lab., IL (USA). Jul 1988. In *Environmental Research Division technical progress report: January 1986-October 1987.* Order Number DE88016165/JAW. Available from NTIS, PC A12/MF A01.

Significant changes occurred in the Environmental Effects Research Program (EERP) at ANL during 1986. Participation in the National Crop Loss Assessment Network was terminated, while a new program was initiated to identify those environmental and operational parameters that lead to the development and persistence of acidic lakes. As part of an initiative to establish an accelerator mass spectrometry facility at Argonne, initial research was begun towards building expertise in tracing and dating ground waters by using the cosmogenically produced radionuclides ^{36}Cl and ^{14}C. While initial ^{36}Cl results have been obtained for constraining the ages of deep ground waters underlying the Savannah River Plant in Aiken, South Carolina, the research is not yet sufficiently advanced to report here. Work has progressed in understanding soil-plant interaction processes with added emphasis on the structural changes that occur in soils because of their association with different plant communities. Aquatic radiochemistry research has continued to focus on understanding those processes that regulate the biogeochemical behavior of important, long-lived radionuclides in the environment. A brief discussion is presented of progress in each of these programs.

40918 (DOE-RW–89.015) **Man made radionuclides in the environment of Dumfries and Galloway. Final report.** Garland, J.A.; McKay, W.A.; Cambray, R.S.; Burton, P.J. Department of the Environment, London (UK). 1989. 66p. (AERE-R–13223). Order Number DE89632950/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Measurements were made on the Solway coast to determine the distribution of radioactivity in the sea and to estimate the extent of transfer of radioactivity from the sea to the air and land. The results would provide a basis for the development of a model describing the transfer process, allowing an estimate of the consequent radiation exposure to the population to be made. The variations of the concentrations of plutonium, americium and caesium in sea water, sand and sediment along the coastline were explained in relation to geographical factors and the mineralogy of the sediments. The inventory of radioactivity in the sediments of Wigtown Bay and the Cree Estuary, and the tidal transfer into and from the estuary were also assessed. Measurements of sea spray, airborne particulate material and deposition provided unambiguous evidence of the transfer of radioactivity from the sea inland. Caesium isotopes from the Chernobyl accident were also evident in the air and deposition samples, and made some contribution to the activity in intertidal sediments. A preliminary assessment of the radiological significance of all the radioisotopes measured in the study shows the resulting doses to the population of Dumfries and Galloway to be small compared with accepted standards. (author).

40919 (INIS-mf–11495, pp. 160-162) **Effect of filtration on the measured levels of uranium and thorium series radionuclides in groundwater.** Payne, T. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Nightingale, T. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Particulate and dissolved material in groundwater pumped from a borehole in the Koongarra uranium deposit (Northern Territory) was fractionated using filtration and ultrafiltration. Levels of thorium and uranium series radionuclides were measured in each size range using α-spectrometry. Thorium and actinium were mostly associated with particulate matter above 1 μm in size. An unusually high $^{227}Ac/^{230}Th$ ratio was found on the particulates. The majority of the uranium was dissolved. The uranium concentration in the pumped groundwater was strongly time-dependent. Colloidal particles between 5 nm and 1 μm in size carry only a small proportion of the radionuclides present in unfiltered groundwater.

40920 (NUREG/CR–5387) **Low-level waste shallow land disposal source term model: Data input guides.** Sullivan, T.M.; Suen, C.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Brookhaven National Lab., Upton, NY (USA). Jul 1989. 322p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (BNL-NUREG–52206). Available from NTIS, PC A14/MF A01 - GPO - OSTI.

This report provides an input guide for the computational models developed to predict the rate of radionuclide release from shallow land disposal of low-level waste. Release of contaminants depends on four processes: water flow, container degradation, waste from leaching, and contaminant transport. The computer code FEMWATER has been selected to predict the movement of water in an unsaturated porous media. The computer code BLT (Breach, Leach, and Transport), a modification of FEMWASTE, has been selected to predict the processes of container degradation (Breach), contaminant release from the waste form (Leach), and contaminant migration (Transport). In conjunction, these two codes have the capability to account for the effects of disposal geometry, unsaturated/water flow, container degradation, waste form leaching, and migration of contaminants releases within a single disposal trench. In addition to the input requirements, this report presents the fundamental equations and relationships used to model the four different processes previously discussed. Further, the appendices provide a representative sample of data required by the different models. 14 figs., 27 tabs.

40921 (OEFZS–4489, pp. 157-181) **Uptake of radioactive cesium into the aquatic vegetation of Styria, Austria.** Ahamer, G. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik); Mueller, H.; Oswald, K.; Heinrich, G.; Kolmer, H.; Klima, K.; Pacher, F. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

During summer and autumn 1987 samples of 150 aquatic plants and the corresponding sediments of 26 locations like lakes, ponds and disconnected parts of rivers were measured for ^{137}Cs, ^{134}Cs and ^{40}K- radioactivity. Sediments were characterized by determination of weight loss after heating, extractable Cs and K, pH(KCl), particle size distribution, content of clay minerals etc. The procedure of uptake of radioactive cesium was subdivided into the steps: fallout - resorption by soil - cesium in plants. This enabled a more differentiated modelling: both the transfer factor TF and the resorption was correlated with describing parameters in order to show the most striking dependencies. First results for the resorption by soil show strong dependence on the percentage of dry matter and on the content of muscovite (mica) in the sediment. The uptake in

plants is mostly depending on the content of ^{137}Cs in the sediment itself, on the content of montmorillonite (weathered mica) and on the transfer factor of ^{40}K which is expressing the potassium affinity of the 30 different collected plant species. 20 refs., 15 figs.

40922 (YJT–89-04) **Solubility and speciation calculations for Pu, Np and Th in simulated groundwaters.** Snellman, Margit. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). May 1989. 25p. Order Number DE89632953/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The solubility and speciation of Pu, Np and Th in simulated groundwaters were calculated using geochemical codes PHREEQE and EQ3NR. The composition of granitewater and bentonitewater simulate conditions in granitic bedrock and the repository, respectively. The database used in this study is stage 2 CHEMVAL database.

40923 Sensitivity of radionuclide transport in groundwater to source and site characteristics. Walton, J.C. (Idaho National Engineering Lab., Idaho Falls, ID (US)); Bensky, M.S.; Mease, M.E.; Bander, T.J. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

A methodology for identification of parameter combinations which can lead to significant degradation of total system performance of a waste repository is described. An analytical solution with dimensionless variables is utilized. The technique is intended to serve a screening function by identifying scenarios which may require more detailed modeling.

5205 Site Resource and Use Studies

Refer also to citation(s) 40008, 40019, 41025

5206 Regulations

Refer also to citation(s) 40876

53 ENVIRONMENTAL–SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social and Economic Studies

40924 (CRIE–Y-88007) **Multi-sectoral econometric modelling Part 2. Theoretical structure of the model.** Hattori, Tsuneaki. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Sep 1988. 21p. (In Japanese). Order Number DE89760363/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

Theoretical structure of the model was investigated on the multisectional econometric model incorporated into the medium term economic forecasting system up to 2000. Economic variables incorporated into the model are determined and the basic interrelationships(causal relations) between economic variables are established by surveying the movement of real economy to carry out this operation. Multi-sectoral econometric model is separated into blocks such as expenditure(final demand), employment-wage, price, value-added formation, electrical demand, etc. and 10 blocks including production determination(industrial structure) are constructed by adding to the above ones. New SNA statistics and simple time-series input-output tables are consistently linked via converter(data conversion ratio). For these reasons, multi-sectoral econometric model can clarify the interdependence between macro economy and industrial structure, and three basic factors as to economic circular flow between production, distribution and expenditure can consistently be understood. 6 references, 4 figures.

40925 (CRIE–Y-88008) **Multi-sectoral econometric modelling (Part 3). Estimation of the pilot-model.** Hattori, Tsuneaki; Sakurai, Norihisa; Nakanishi, Yasuo; Ito, Nariyasu; Inoue, Yoshiro. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Sep 1988. 32p. (In Japanese). Order Number DE89760364/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

As regards each of the theoretical formulas of multi-sectoral econometric modeling, to be implicated in the medium term economic forecasting system, the different functions, by applying actual data, were assumed. The assuming work, by excluding blocks expressing the definitional relation in the value-added formation, etc., was made under the division into 8 blocks, i.e., expenditure, employment/wage, price, potential production, electrical demand, household, corporation and government. The assumption formulas (action equations) are approx. 250 in total number. The assumption is generally good in result, judging from the determination coefficients, etc. of each of assumption formulas, which appropriately seizes the movement of actual economy. As a main result of assumption, the determining method in private plant investment, wage, etc. is, with the classification by industry, individually and characteristically different. The production price with the classification by industry, can be explained, by the full cost principle added with the supply and demand condition. A consumption sub-model, separately developed, adopted a linear expenditure system model, seizing the change in contents of consumption as a linear function, and resulted in a good assumption. 21 references, 8 figures, 2 tables.

40926 (CRIE–Y-88009) **Multi-sectoral econometric modelling (Part 4). Features of the pilot-model.** Hattori, Tsuneaki; Sakurai, Norihisa; Nakanishi, Yasuo; Inoue, Yoshiro. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Sep 1988. 21p. (In Japanese). Order Number DE89760365/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

In the next stage through the development of multi-sectoral econometric modelling, to be implicated in the medium term economic forecasting system, by implicating the different assumed functions as a simultaneous equation system, a demonstration model (hereafter called pilot-model), which can appropriately explain the actual economy as a whole, is to be resturctured. The developed pilot-model characteristically is a new SNA (national economy calculation) type model, composed of approx. 400 equation systems inclusive of definition formulas. As a result of different interpolation tests made in order to discuss the forecasting ability of model, the total test (in 1972 through 1984) resulted in the error factors in basic variables, being 1.5% in substantial GNP, 2.2% in consumer price and 1.6% in substantial expenditure, which were generally small with reliability practicability as a forecasting model. A long term economic prospects until 2000 were made and resulted in a possible exepctation that the substantial GNP continues to be around the middle between 3 to 4% in growth rate until 2000. 5 references, 2 figures, 4 tables.

40927 (ETDE-mf–9795113) **Engineering and the constitution.** Herzog, R. Bundesverfassungsgericht, Karlsruhe (Germany, F.R.). 1988. 18p. (In German). Order Number DE89795113/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Paper presented on the occasion of the annual reception of the Kernforschungszentrum Karlsruhe, October 3, 1988.

We can see at every turn how instruments once used for the good of mankind become blunt right before our very eyes. They still serve their purpose, but each further step brings about less additional benefit ('residual benefit'). This is a fundamental problem rather than a detail problem, as it is the self-concept, reliability and stability of our public order that is at risk. 'Constitution' in this sense is more than just the legal basis of the state; as used by the author it refers to the laws governing a society's life. (orig./HSCH).

5302 Assessment of Energy Technologies

40928 (ERCB-D–89-2) **240-kv transmission line 946/947L Ellerslie-est Edmonton.** Energy Resources Conservation Board, Calgary, AB (Canada). 1989. 33p. (CE–02692). Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, Canada T2P 3G4; $N/C.

This report details the TransAlta Utilities Corportation (TransAlta) application for approval to construct and operate a double-circuit 240-kV transmission line in the Ellerslie-East Edmonton area. The Board believes the following to be the major issues involved in the TransAlta application: need for the proposed transmission line, potential health effects of electric and magnetic fields (EMGs), and route for the proposed transmission line, to be discussed according to the following matters: regulatory considerations, potential effects on health or safety of residents, environmental issues, economic and technical matters, and planning and land use. After thorough consideration of the application the Board is satisfied that the need for the proposed line and the benefits that would result from it outweigh any negative consequences associated with its construction and operation and has decided to approve construction of the 240-kV double-circuit steel tower transmission line. 1 ref.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 40341

5502 Biochemistry

Refer also to citation(s) 40120, 40121, 40675, 40943, 41003, 41061

40929 (DOE/ER/13367–4) **[Corn storage protein: A molecular genetic model]: Progress report for 1989.** Rutgers–the State Univ., Piscataway, NJ (USA). Waksman Inst. of Microbiology. 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-85ER13367. Order Number DE89015816/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The major emphasis on our research has been on the 10 kD zein or high methionine protein which is also encoded by single gene. Differential expression of this gene among different inbreds depends on transacting factors. A putative tafA locus, now called Zpr10/(22), causes increased accumulation of 10 kD mRNA at a posttranscriptional level. We also have preliminary evidence that Zpr10/(22) itself is controlled by a form of imprinting when crossed with certain maize strains. We would like to identify the imprinting mechanism in genetic crosses and study biochemically the posttranscriptional regulation of the differential accumulation of 10 kD mRNA in the presence of Zpr10/(22). 8 refs.

40930 (DOE/ER/13424–3) **Development of methods to structurally characterize complex carbohydrates: Three-year renewal, December 15, 1989–December 14, 1992 and Progress report, December 1986–June 1989.** Albersheim, P.; Darvill, A. Georgia Univ., Athens, GA (USA). Complex Carbohydrate Research Center. Jun 1989. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-85ER13424. Order Number DE89015798/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The most distinguishing attribute of our research program is the combination of state-of-the-art structural characterization of complex carbohydrates with emphasis on molecules possessing important biological functions. Over the past few years we have developed methods to unravel the structures of the polysaccharides of plant cell walls and methods to generate, purify, and structurally characterize oligosaccharins. The methods we continue to develop enable us to take on ever more difficult projects and thereby make progress in our studies of the structures and functions of plant cell wall polysaccharides and oligosaccharins. The methods we have developed for the study of the complex carbohydrates of plants have proven of value as well in studies of the structures and functions of the complex carbohydrates of bacteria, fungi, and animals.

40931 (DOE/ER/13425–3) **The structures and functions of oligosaccharins: Progress report, December 1986–June 1989.** Albersheim, P. Georgia Univ., Athens, GA (USA). Complex Carbohydrate Research Center. Jun 1989. 48p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-85ER13425. Order Number DE89015799/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

It has been about six years since we recognized the regulatory properties of complex carbohydrates and coined the term oligosaccharin to refer to such molecules. This grant has been supporting two major areas of oligosaccharin research: (i) regulation of plant morphogenesis and (ii) regulation of plant-pathogen interactions. Much progress has been made in identifying factors that regulate plant morphogenesis such as environmental stimuli like light and temperature and molecules endogenous to plants, like the phytohormones cytokinin and auxin. Recently, oligosaccharins have been shown to be capable of regulations morphogenesis. 226 refs.

40932 (ETDE-mf–9794749) **Experiments on somatic hybridization of Schwanniomyces and Saccharomyces for the purpose of ethanol production from starch.** Hintz, M. Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. 25 Nov 1987. 144p. (In German). Order Number DE89794749/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01.

The intergeneric fusions of the Schwanniomyces mutants DM1 and MM1 with different saccharomyces strains was accomplished by chemical processes according to different selection criteria. By a combination of gel filtration and affinity chromatography, a purification method was obtained, which allows with simultaneous good yield, the isolation of two electrophoretically pure amylases: a glucoamylase with a MW of about 110.000 and an α-amylase with a MW of 45.000. Both enzymes were glycoproteins. The biochemical properties of the amylases suggest that for the degradation of amylaceous substrates, the glucoamylase was the better suited enzyme. (orig./EF).

40933 (ORNL/FTR–3312) **[Use of carbon dioxide in inorganic, organic, and bioorganic reactions, Ginosa, Italy, June 17–28, 1989]: Foreign trip report.** Smith, H.B. Oak Ridge National Lab., TN (USA). 14 Jul 1989. 5p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE89015090/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the NATO Advanced Study Institute in Ginosa, Italy, and presented an oral summary of his research entitled "Subtle Structural Perturbations at the Active Site of Rubisco by Concerted Site-Directed Mutagenesis and Chemical Modification." Topics of the Institute included the chemical fixation, electrochemical and chemical reduction of carbon dioxide, and enzymatic reactions of carbon dioxide. Discussion of ribulose bisphosphate carboxylase/oxygenase, the enzyme that catalyzes by far most of the earth's yearly carbon dioxide fixation, highlighted ongoing investigations of the enzyme within the Protein Engineering Program of ORNL's Biology Division.

40934 (PNL-SA–16632) **Electrospray ionization mass spectrometry and tandem mass spectrometry of small oligonucleotides.** Edmonds, C.G.; Barinaga, C.J.; Loo, J.A.; Udseth, H.R.; Smith, R.D. Pacific Northwest Lab., Richland, WA (USA). May 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8905166–7: American Society for Mass Spectroscopy annual symposium, Miami Beach, FL (USA), 22-26 May 1989). Order Number DE89014926/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have carried out a preliminary evaluation of electrospray ionization (ESI) mass spectrometry for the analysis of small oligonucleotides. In addition to the qualitative and quantitative potential suggested by the success of ESI of peptides and proteins, ESI tandem mass spectrometry may also be amenable of large oligonucleotides is usually performed by chemical degradation or by the chain termination technique. Smaller oligonucleotides have been analyzed by mass spectrometry with advantages in speed and simplicity of analysis. Tandem spectrometry has been effectively employed for the singly charged molecular anions of oligonucleotides to a polymerization level of $n = 6^4$. Fenn and co-workers have reported the ESI of nucleotide mono-, di- and triphosphates. A ESI mass spectrum of a deoxynucleotide 14-mer has also been recently reported.

40935 (UCRL–101218) **Monoclonal antibody based immunoassays for cooking-induced meat mutagens.** Vanderlaan,

M.; Hwang, M.; Knize, M.G.; Watkins, E.; Felton, J.S. Lawrence Livermore National Lab., CA (USA). 29 Jun 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907113–2: 5. international conference on environmental mutagens, Cleveland, OH (USA), 10-15 Jul 1989). Order Number DE89015115/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We report here new monoclonal antibodies (Mabs) numbered AIA-8 through AIA-12 produced using the same methods used to produce AIA-1, and a new Mab, IQ-7, produced with the same methods used for IQ-1. Our motivation in seeking these new clones was to increase the repertoire of available Mabs to insure adequate coverage of all known AIAs. Also, the mice used to produce these new hybridoma clones had been immunized about six months longer than those used to generate the first clones. Longer immunization is often associated with higher affinity Mabs and therefore more sensitive competition immunoassays. 15 refs., 2 figs., 2 tabs.

5503 Cytology

40936 (UCRL–101502) **Cytogenetics of human sperm: Structural aberrations and DNA replication.** Brandriff, B.F.; Gordon, L.A.; Carrano, A.V. Lawrence Livermore National Lab., CA (USA). 11 Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8907113–4: 5. international conference on environmental mutagens, Cleveland, OH (USA), 10-15 Jul 1989). Order Number DE89015330/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The human sperm-hamster egg system, first introduced in 1978 (Rudak et al), has yielded some important insights into questions on chromosomal integrity of human sperm. In this system, human sperm are co-incubated with eggs from the golden hamster. After the gametes fuse, eggs are cultured overnight and approximately 15 hours after fusion, display the haploid chromosomal complement of individual human sperm cells. These chromosomes can be analyzed by standard banding techniques to identify and quantify structural and numerical abnormalities in single sperm. 32 refs., 1 fig.

5504 Genetics

Refer also to citation(s) 39798, 40120, 40121, 40929, 40936, 41003

5505 Metabolism

Refer also to citation(s) 39846, 40933, 40942

5506 Medicine

Refer also to citation(s) 40676, 40776, 40830, 40986

40937 (BNL–43009) **A beam-modification assembly for experimental neutron capture therapy of brain tumors.** Slatkin, D.N.; Kalef-Ezra, J.A.; Saraf, S.K.; Joel, D.D. Brookhaven National Lab., Upton, NY (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8903150–1: Workshop on neutron beam design, development and performance for neutron capture therapy, Cambridge, MA (USA), 30-31 Mar 1989). Order Number DE89015102/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent attempts to treat intracerebral rat gliomas by boron neutron capture therapy (BNCT) have been somewhat disappointing, perhaps in part because of excessive whole-body and nasopharyngeal irradiation. Intracerebral rat gliomas were treated by BNCT with more success using a new beam-modification assembly. 3 refs., 2 figs.

40938 (BNL–43035) **Delayed effects of neutron irradiation on central nervous system microvasculature in the rat.** Goodman, J.H.; McGregor, J.M.; Clendenon, N.R.; Gordon, W.A.; Yates, A.J.; Gahbauer, R.A.; Barth, R.F.; Fairchild, R.G. Brookhaven National Lab., Upton, NY (USA). 1988. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8802102–5: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), Upton, NY (USA), 1-2 Feb 1988). Order Number DE89015098/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Pathologic examination of a series of 14 patients with malignant gliomas treated with BNCT showed well demarcated zones of radiation damage characterized by coagulation necrosis. Beam attenuation was correlated with edema, loss of parenchymal elements, demyelination, leukocytosis, and peripheral gliosis. Vascular disturbances consisted of endothelial swelling, medial and adventitial proliferation, fibrin impregnation, frequent thrombosis, and perivascular inflammation. Radiation changes appeared to be acute and delayed. The outcome of the patients in this series was not significantly different from the natural course of the disease, even though two of the patients had no residual tumor detected at the time of autopsy. The intensity of the vascular changes raised a suspicion that boron may have sequestered in vessel walls, resulting in selectively high doses of radiation to these structures (Asbury et al., 1972), or that there may have been high blood concentrations of boron at the time of treatment. The potential limiting effects of a vascular ischemic reaction in Boron Neutron Capture Therapy (BNCT) prompted the following study to investigate the delayed response of microvascular structures in a rat model currently being used for pre-clinical investigations. 8 refs., 3 figs., 1 tab.

40939 (GSF–2/89) **DIN standards part 1 for medical applications of ionizing radiation.** Loester, W.; Kraft, A. Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz. Jan 1989. 25p. (In German). Order Number DE89794857/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report contains a list of the appropriate DIN standards as of 1989. (HP).

40940 (INIS-mf–11495, pp. 218-219) **Operational programme for the national medical cyclotron.** Boyd, R.E. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

On the 19th August 1986, the Minister for Resources and Energy announced a Budget provision of $0.2 million for the first phase of the construction of a medical cyclotron to be owned and operated by the AAEC. The development was also to include the establishment of a national positron emission tomography (PET) facility to be used in conjunction with the Royal Prince Alfred Hospital in Sydney. The total cost of the development was estimated at $14.2 million over four years. The cyclotron will extend the range of radioisotopes currently used in diagnostic medicine by providing access to those which are neutron deficient and cannot be effectively produced by any other means. The cyclotron will produce radioisotopes for consumption in hospitals throughout Australia, including iodine-123, thallium-201 and indium-111.

40941 (INIS-mf–11502, pp. 53-55) **Measurements of ^{32}p activity in radiotoxicological samples.** Izak-Biran, T. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Friedman, K.; Shamai, Y. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40942 (ORNL/TM–11224) **Nuclear Medicine Program progress report for quarter ending March 31,1989.** Knapp, F.F. Jr.; Ambrose, K.R.; Callahan, A.P.; McPherson, D.W.; Srivastava, P.C.; Allred, J.F.; Blystone, S.L.; Hasan, A.; Kropp, A.; Lambert, C.R. Oak Ridge National Lab., TN (USA). Aug 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014367/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this report a general route for iodination of alkynes using iodine monochloride (ICl) is described. Several alkyne substrates including pargyline and tremorine have been converted to the

iodochloroalkene products in good yields. Although the stereochemistry of the addition has not yet been determined, the iodine-125-labeled products are readily prepared and this appears to be a simple general route for radioiodination of alkyne substrates. Also in this report, the syntheses of two radioiodinated spiroperidol analogues with iodoalkenyl- substitution on the lactam nitrogen are described. The methods for preparation of these analogues include iododeboronation and iododestannylation using no carrier-added iodine-125. The N-(5- iodopenten-1-yl) and N-(3-iodopropen-1-yl) analogues of spiroperiodal have been prepared. 4 refs.

40943 (PNL–6800-Pt.1) **Pacific Northwest Laboratory annual report for 1988 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.** Park, J.F. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 132p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. Order Number DE89013991/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report summarizes progress on OHER biomedical and health-effects research conducted at PNL in FY 1988. The research develops the knowledge and scientific principles necessary to identify, understand, and anticipate the long-term health consequences of energy-related radiation and chemicals. Our continuing emphasis is to decrease the uncertainty of health-effects risk estimates from existing and/or developing energy-related technologies through an increased understanding of how radiation and chemicals cause health effects. The report is arranged to reflect PNL research relative to OHER programmatic structure. The first section, on human health effects, concerns statistical and epidemiological studies for assessing health risks. The next section, which contains reports of health-effects research in biological systems, includes research with radiation and chemicals.

5507 Microbiology

Refer also to citation(s) 39798, 39816, 39846, 40118

5530 Agriculture and Food Technology

Refer also to citation(s) 40090, 40099, 40121

40944 (IAEA-TECDOC–490, pp. 19-38) **Toxicological safety and nutritional adequacy of irradiated foods.** Diehl, J.F. (Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8804282–: Task force meeting on public information of food irradiation, Cadarache (France), 18-21 Apr 1988). In *Safety factors influencing the acceptance of food irradiation technology. Report of a task force meeting on public information of food irradiation convened by the International Consultative Group on Food Irradiation and held in Cadarache, France, 18-21 April 1988.* Order Number DE89619871/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Considerations of the health safety of irradiated foods involve four aspects: radiological safety, toxicological safety, nutritional adequacy, and microbiological safety. The first three topics are discussed in this report. In contrast to widespread public opinion, irradiated foods do not become radioactive by this treatment, and radiological safety is the least controversial of these topics. The toxicological safety of irradiated foods has been investigated by short-term (in vitro) tests, by long-term animal feeding studies, by tests with human volunteers, and by radiation chemical analysis. While the vast majority of investigations have demonstrated that irradiated foods have no harmful effects, some results have necessitated careful re-evaluations. These have shown that the apparent detrimental effects were due to biological variability or faulty experimental design or evaluation. The nutritional adequacy of irradiated foods has been tested by chemical analysis and by animal feeding studies. While protein quality is little affected even by high doses of radiation, some vitamins are partly destroyed by the treatment. This can be largely avoided by choosing appropriate processing conditions, e.g. exclusion of oxygen. The Joint FAO/IAEA/WHO Expert Committee on Irradiated Food (JECFI), at its meeting in 1980, reviewed the results of research carried out in numerous countries over a period of more than 20 years. The committee concluded that the irradiation of any food commodity up to an overall average dose of 10 kGy presents no toxicological hazard, and that further toxicological testing of foods so treated was not required. JECFI also considered that the irradiation of food in this dose range introduces no special nutritional or microbiological problems. 34 refs, 1 fig., 1 tab.

40945 (IAEA-TECDOC–490, pp. 53-75) **Microbiological safety of irradiated foods.** Farkas, J. (University of Horticulture and Food Industry, Budapest (Hungary). Inst. of Food Technology). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8804282–: Task force meeting on public information of food irradiation, Cadarache (France), 18-21 Apr 1988). In *Safety factors influencing the acceptance of food irradiation technology. Report of a task force meeting on public information of food irradiation convened by the International Consultative Group on Food Irradiation and held in Cadarache, France, 18-21 April 1988.* Order Number DE89619871/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The paper attempts to summarize relevant information on microbiological safety of irradiated foods in the light of previous reports of expert committees and current literature references. After a brief overview of the relative radiation resistance of food-borne microorganisms the importance of microbial load for dose requirement, and the role of post-irradiation conditions, it addresses the following questions: Could selective changes in the microflora caused by non-sterilizing radiation doses make known pathogens more likely to occur, or bring into prominence unfamiliar pathogens? Is it probable that "mutational" (including adaptive) changes might make pathogens more virulent, more harmful, or more difficult to recognize, and could new pathogens arise in this way? Is it possible that development of radiation resistant strains might render the antimicrobial irradiation processes ineffective? The present survey of relevant scientific evidence related to these questions reaffirms the basic conclusion of earlier reviews that microbiological safety of irradiated food is fully comparable with that of foods preserved by other acceptable preservation methods. Similar to other preservation processes, gains in microbiological or keeping quality attained by food irradiation can be and must be safeguarded by proper control in the food irradiation facilities and by proper care of the product before and after processing. (author). 99 refs.

40946 (IAEA-TECDOC–490, pp. 39-52) **Radiolytic products - Are they safe.** Merritt, C. Jr. (Army Natric Research and Development Command, MA (USA)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8804282–: Task force meeting on public information of food irradiation, Cadarache (France), 18-21 Apr 1988). In *Safety factors influencing the acceptance of food irradiation technology. Report of a task force meeting on public information of food irradiation convened by the International Consultative Group on Food Irradiation and held in Cadarache, France, 18-21 April 1988.* Order Number DE89619871/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The Joint FAO/IAEA/WHO Expert Committee on the Wholesomeness of Irradiated Food (JECFI), convened in 1976, recognized the significance of the formation of radiolytic products in irradiated foods as a means of evaluation of safety of foods so treated. To provide additional data on radiation chemistry of food and its constituents, the International Project in the Field of Food Irradiation established a Co-ordinated Programme on the Radiation Chemistry of Food and Food Components (CORC) in 1978. Data generated by various laboratories under CORC were submitted to the JECFI convened in 1980 for evaluation. This JECFI stated that radiation chemistry studies showed that the radiolytic products of major food components are identical, regardless of the food from which they are derived. Most of these radiolytic products have also been identified in foods subjected to other, accepted types of food processing. Knowledge of the nature and concentration of these radiolytic products indicates that there is no evidence of a toxicological hazard. Data from published literature showed that radiation chemical behavior in foods is predictable, reproducible, can be related to food composition and can be measured qualitatively and quantitatively. In all studies on radiolytic products, no product has ever been identified in an irradiated food which is unique. Data from wholesomeness studies of beef irradiated with a dose up to 58 kGy in the USA

demonstrated that there is no evidence to suggest that the volatile radiolytic compounds in beef so treated would constitute a hazard to the consumer's health. (author). 27 refs, 1 fig., 3 tabs.

40947 (INIS-mf–11495, pp. 210-211) **Measurement of protein content of meat using an accelerator.** Boldeman, J.W. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Walsh, R.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A charged particle accelerator has been used to measure protein in meat. This is done by measuring the transmission of neutrons at 432 keV resonance in nitrogen and by performing calculations of nuclear scattering.

40948 (INIS-mf–11495, pp. 212-214) **Rapid determination of selenium in human serum by neutron activation analysis.** McOrist, G.D. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Energy Chemistry); Fardy, J.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A simple and rapid method was developed for the determination of selenium in human serum using a pre-irradiation separation technique of ultrafiltration followed by neutron activation analysis via the short-lived activation product ^{77m}Se. The method was validated using certified reference material.

40949 (INIS-mf–11495, pp. 215-217) **Heavy metal distribution in brindled and normal mouse tissue.** Kirby, B.J. (Melbourne Univ., Parkville (Australia). School of Physics); Legge, G.J F.; McArdle, H.; Danks, D.M. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The Melbourne scanning proton microprobe has been used for an investigation of the sub-cellular distribution of heavy metals and other elements in 10 day old brindled and normal mouse ileum tissue. A Cu concentration an order of magnitude higher in mutant tissue than in normal tissue was found, confirming previous results. Ratios of x-ray yields from outer villus tip to inner villus tip irradiated areas were taken and compared for mutant and normal mice after normalising to the bremsstrahlung yield in each case. A strong peripheral concentration of Fe was found in both mutant and normal tissues, and the Cu peripheral concentration appears to be higher (relative to the inner area) in the mutant than in the normal, which has implications in determining the cause of a defective Cu transport site in mutant ileum epithelial cells.

40950 (OEFZS–4489, pp. 222-229) **Supplement to investigation of technology process of cesium-134,137 decontamination of beef and lamb meet.** Draganovic, B. (Belgrade Univ. (Yugoslavia)); Micic, G. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

We tried in our investigation to modify certain methods of contamination of meat, contaminated by feeding with radioactive grass and hay. We present data concerning the decontamination of the fresh meat of animal fed on radioactive foods, and the follow up of the ^{134}Cs - ^{137}Cs mixture. The contamination procedure of lamb meat was performed in the different manners, namely by external salting of the fresh meat with the sea salt during 4 hours on the temperature of 4^0 C, and by pressure cooking lasting 15 minutes, followed by the buillon extraction. The decontamination procedure of veal was performed by the sinking of the meat samples in a 4% acetic acid, with meat-acid ratio being 1:3 on 8^0 C during the period of 4 days. Pressure cooking was performed on the temperature of 120^0 C with the pressure of $2{,}02.10^5$ N/m^2 (2 Atu) lasting 15 minutes after which the buillon was extracted and split. Data analysis shows that the salting of the lamb meat produced the 83% activity loss in ^{134}Cs and ^{137}Cs and the pressure cooking even larger effect of over 90%. The veal meat after acetic acid treatment lost more than 80% ^{134}Cs and ^{137}Cs. Pressurized cooking increase the contamination effect to 95%. 2 refs., 4 tabs. (nev).

40951 (OEFZS–4489, pp. 236-245) **Reduction of gastro-indestinal radio-cesium-adsorption in domestic animals by a special feed additive: ammonium-ferric-cyano-ferrate (AFCF).** Giese, W.W. (School of Veterinary Medicine, Dept.of Medical Physics, Hannover (Germany, F.R.)). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The group of ferrocyanides was tested as a Cesium binding antidotes in laboratory and in domestic animals during and after the atmospheric atomic bomb tests. One of them, featuring an extremely high efficiency in Cesium binding and excretion, Ammonium-Ferric(III)-Cyanoferrate(II) was investigated with regard to its group chemistry, crystallographic structure and mode of action. Additional in vivo tests and practical applications are briefly discussed. 12 refs., 2 figs., 1 tabs. (qui).

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

Refer also to citation(s) 40341

5601 Radiation Effects

Refer also to citation(s) 40032, 40063, 40278, 40310, 40311, 40312, 40348, 40804, 40808, 40809, 40901, 41063

40952 (DOE/ER/60393–4) **Mutagenic effect of tritium on DNA of Drosophila melanogaster: Comprehensive performance report, June 1, 1988–June 30, 1989.** Lee, W.R. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Zoology and Physiology. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER60393. Order Number DE89015925/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The first objective was to induce mutations at the Adh locus in Drosophila melanogaster using the procedures and dosimetry that we have reprints developed. The linear dose response for the doses used by others would indicate that at that high dose, the mutations will be based predominately on the same mechanisms of mutagenesis as that of lower exposure levels. The frequency of mutations induced at 25G is 100 times the spontaneous frequency; therefore, the mutation spectrum should be that of the tritium beta radiation with a non significant contribution from spontaneous mutations. These tritium induced null mutations were then analyzed by complementation genetic tests using both deletions and specific locus mutations near the Adh locus. Following the genetic analysis, molecular analysis will be conducted on these mutations. 1 tab.

40953 (EPRI-NP–5678) **Below regulatory concern owners group: Assessment of discrete radioactive particle dose: Final report.** Rogers, V.C.; Vance, J.N. Electric Power Research Inst., Palo Alto, CA (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA); Vance and Associates, Ruidoso, NM (USA). c Jul 1989. 58p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A dose assessment has been performed for discrete radioactive particle (DRP) exposures which could potentially occur from the disposal of BRC waste. The particles are assumed to initially be

present in dry active waste from nuclear power plants that has been disposed under a below regulatory concern disposal rule. Ingestion of the DRP is the most limiting pathway, with a 30 uCi (gamma activity) DRP potentially resulting in an effective dose equivalent of 100 mrem. The annual probability for this and other exposure events is estimated to be less then 10-8. 14 refs., 8 tabs.

40954 (EPRI-NP–5683) **Below Regulatory Concern Owners Group: Doses to the maximally exposed individual from NRC-licensed activities: Final report.** Waite, D.A.; Dolan, M.M.; Mantooth, D.S. Electric Power Research Inst., Palo Alto, CA (USA); Envirosphere Co., Bellevue, WA (USA). c Jul 1989. 28p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report estimates the additional radiation dose potentially received by the maximally exposed individual (MEI) from the disposal of Below Regulatory Concern (BRC) waste from other NRC-licensed activities potentially resulting in exposures to members of the general public. The MEI for BRC waste disposal has been identified as the driver of the disposal truck containing BRC waste. The additional doses received by the BRC waste truck driver are determined by identifying the following: (1) the MEI from NRC-licensed activities that result in exposures to the general public (documented in the literature); and (2) the likelihood that the truck driver is also the MEI for those activities. The likelihood that the truck driver is also the MEI from other activities is evaluated based on the time of the potential exposure, its geographic proximity to the BRC waste MEI, and the critical exposure pathway. 3 refs., 1 tab.

40955 (INIS-mf–11495, pp. 206-209) **Biological applications of ionizing radiation.** Lavin, M.F. (Queensland Univ., St. Lucia (Australia). Dept. of Biochemistry). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Ionizing radiation is cytotoxic, mutagenic and carcinogenic. For these reasons it provides an important line of research for the radiation biologist. It exerts its cytotoxicity primarily by its damaging effects on DNA but also by causing damage to a variety of other structures in the cell such as organelles and membranes. The mutagenic effects of ionizing radiation are due to a variety of lesions in DNA that include single and double strand breaks, base modifications and misrepair of damage. The well established correlation between carcinogenicity and mutagenicity can readily account for the ability of radiation to cause cancer. Over the past several years we have studied the effects of radiation on human cells. We have employed both γ-rays (^{60}Co source) and neutrons (produced in the Van de Graaff at Lucas Heights) in this project. Our overall aim was to understand in greater detail the relationship between radiation damage, cell death and malignancy. This general approach has allowed for the elucidation of DNA repair mechanisms and identification of enzymes involved in these processes.

40956 (INIS-mf–11502, pp. 33-39) **Exposure of the public to ionizing radiation due to smoking.** Schlesinger, T. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Margaliot, M.; Shamai, Y.; Eisenberg, A. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The average radiation dose to the lungs of smokers due to radioactivity in the tobacco is not negligible, but it is small compared with the dose to the lungs of these smokers, (and for any other human being) from their exposure to environmental radiation due to the inhalation of radon and its daughters. There is no logical reason to calculate the dose due to these two very similar environmental contaminations by using two different dosimetry approaches. In no way should this conclusion result in an underestimation of the carcinogenicity of tobacco smoke which we have to attribute to the many other carcinogenic agents in the tobacco.

40957 (INIS-mf–11502, pp. 86-87) **Mechanism of benzene carcinogenicity. Interaction of benzene with ionizing radiation.** Kalir, A. (Tel Aviv Univ. (Israel). Sackler School of Medicine); Braun, R.; Chaitchik, S.; Louis, F.; Levita, M. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40958 (INIS-mf–11502, pp. 62-66) **Ultra violet radiation health physics.** Kushelevsky, A.P. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

40959 (NRCN(LS)–023) **Toxicology of uranium compounds. A literature survey.** Brickner, D. Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev. Nov 1988. 44p. (In Hebrew). Order Number DE89633043/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This review of literature presents and criticises the current knowledge relevant to risk assessment in cases of human exposure to natural uranium compounds due to industrial accidents. The major risk of high uranium exposure is renal-tubular damage which may lead to acute renal insufficiency and death. Radiation damage is not expected in these circumstances. In this review the metabolism of uranium in the body, the health effects and the possible medical treatment are discussed, with an emphasis on relatively large exposure of short duration. The current ICRP lung model does not represent all the factors affecting the kinetics of uranium oxides in the respiratory tract. The significance of these factors, not represented by the model, for risk assessment in such exposures, is not known. The current recommendations for treatment are not scientifically based. Further investigations are urgently needed to enable a rational medical preparadness. 63 refs.; 6 tables; 1 fig.

40960 (OEFZS–4489) **Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.** Gerzabek, M.H. (ed.). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. 282p. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

This is a small part (21 out of 178) of the papers presented at the 19th annual meeting of the European Society of Nuclear Methods in Agriculture, held in 29 Aug to 2 Sept, 1988 in Vienna, i.e. those concerned with the effects of the Chernobyl reactor accident. The content is the fallout distribution after the accident, migration of radionuclides, in particular via the food chains to man, methods of decontamination and estimation of doses received by the population. (qui).

40961 (OEFZS–4489, pp. 274-282) **Chernobyl accident one year later: Genetic damage and ^{137}Cs accumulation in wild rodents in Rome, Italy.** Cristaldi, M. (Rome Univ. (Italy)); Ieradi, L.A.; Mattei, T.; Van Axel Castelli, I.; D'Arcangelo, E.; Mascanzoni, D. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The Chernobyl accident has stressed the importance of studying the consequences of insertion and accumulation of radioactive substances in the environment. The radioactive fallout reaced Rome in May 1986 (ENEA/DISP, 1986) and an investigation was started aimed at studying the effects of the exposure of wild populations to low doses. In order to assess the extent of the genetic damage and

ascertain the existence of a relationship between environmental radioactivity and somatic and germinal damage, mutagenic tests were used on wild rodents. The results obtained through micronucleus test have shown a statistically significant increase of MPCEs/1000 PCEs in all the animals sampled during and after the Chernobyl fallout. The maximum of MPCEs, recorded during the fallout, was the highest obtained, even compared with the wild rodents sampled in other areas and in trapping performed before the Chernobyl accident. The increased mutagenic rate observed in the investigated populations confirms the efficacy of the micronucleus test and the use of wild populations as biological indicators. 34 refs.,1 fig., 2 tabs.

40962 (OEFZS–4489, pp. 246-256) **New Cs-selective ion-exchange resin for the decontamination of radioactive fluids.** Giese, W.W. (School of Veterinary Medicine, Dept.of Medical Physics, Hannover (Germany, F.R.)). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. (CONF-8808202–: 19. annual meeting of the European Society of Nuclear Methods in Agriculture, Vienna (Austria), 29 Aug - 2 sep 1988; LA–210/89). In *Proceedings of the 19. ESNA-conference. Papers presented on after effects of Chernobyl.* Order Number DE89631204/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

Since ammonium-ferric-hexacyanoferrate(II) (AFCF) became known as a very effective antidote against radiocesium when fed in small doses to domestic animals for reducing the absorption of ^{134}Cs and ^{137}Cs in the gastrointestinal tract it seemed logical to test this substance for the decontamination of cesium contaminated biological liquids in ion exchange columns. Ferrocyanides can be chemically bound to resin spheres or special glass beads to form a coarse granulate permitting high flow rates without peptization. The preparation, properties and intended application of such AFCF-granulate are described. 6 refs., 1 tab., 9 figs.

40963 (ORNL/TM–10971, pp. 10-13) **Perspective from a commercial supplier of dosimetry services.** Yoder, R.C. (Tech/Ops Landauer, Inc., Glenwood, IL (USA)). Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The traditional radiation related industries in the United States have matured. The growth rates in the numbers of radiation workers have moderated and ALARA programs have favorably reduced many exposures. Dosimetry testing and accreditation by the National Bureau of Standards have identified those services possessing satisfactory dosimetry systems and technical competence. These developments have influenced the business perspectives. Combined with the overall renewed emphasis on competition and productivity in American business, many dosimetry services have become more aggressive in seeking new markets; residential radon measurements being most obvious. The potential size of these markets is making investments in technical research more attractive. In the past, most research funding was provided by the government. The renewed research interest by the private sector could stimulate the entry of new professionals into radiation measurement research. Research results have the potential for improving traditional services and expanding the applicability of certain measurement methods.

40964 (ORNL/TM–10971, pp. 14-22) **Implementation of the Department of Energy Laboratory Accreditation Program (DOELAP) and the new exposure reporting requirements.** Neeson, P. (Department of Energy, Chicago, IL (USA)). Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The Department of Energy has initiated DOELAP in an effort to standardize on optimum state-of-the-art external dosimetry technology, and to identify anomalies in dosimetry performance in order to determine areas of needed research. The program is analogous to the National Voluntary Laboratory Accreditation Program (NVLAP), but with three essential differences: (a) more stringent tolerance levels, (b) a built-in provision for applied research, and (c) application to a wider spectrum of source terms and dosimetry needs. Accreditation of external dosimetry programs is now mandatory for DOE operations. To initiate the accreditation process, a formalized application is submitted, which describes the dosimetry and defines the irradiation categories in which the dosimeter(s) will be tested. The dosimeters are sent to the DOE-Radiological and Environmental Sciences Laboratory (RESL) at INEL for performance testing, and site assessment is performed at the organization's facilities, to evaluate its handling of dosimetry data and documentation. The DOELAP Oversight Board eventually reviews the results of these functions and makes appropriate recommendations to DOE-HQ. Accreditation is formally granted by HQ and is valid for two years.

40965 (ORNL/TM–10971, pp. 60-67) **Accident level dosimetry with TLD.** Moghari, N.M. (Georgetown Univ., Bethesda, MD (USA)); Devine, R.T. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

Under the sponsorship of the Naval Dosimetry Center (NCD), a series of accident level irradiations were conducted at the Mount Weather Facility of the Federal Emergency Management Agency (FEMA). The irradiations consisted of two sets of exposures involving 50 8800-series TLD cards (DT-648/PD) with Cs-137 photons. The first set of irradiations ranged from 6 to 600 Rad. The purpose was to pre-irradiate the TLD cards, measure the superlinearity of the detector's responses, and then, clear the TLDs for the subsequent exposure. The second set of irradiations were conducted at the same dose levels and with the same TLD cards. The superlinearity of the detector responses were remeasured to establish the effect of accident level photon doses on the TLD responses.

40966 (ORNL/TM–10971, pp. 106-116) **Review of experience with plutonium exposure assessment methodologies at the nuclear fuel reprocessing site of British Nuclear Fuels plc.** Strong, R. (British Nuclear Fuels plc, Sellafield (England)). Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

British Nuclear Fuels plc and its predecessors have provided a complete range of nuclear fuel services to utilities in the UK and elsewhere for more than 30 years. Over 30,000 ton of Magnox and Oxide fuel have been reprocessed at Sellafield. During this time substantial experience has accumulated of methodologies for the assessment of exposure to actinides, mainly isotopes of plutonium. For most of the period monitoring of personnel included assessment of systemic uptake deduced from plutonium-in-urine results. The purpose of the paper is to present some conclusions of contemporary work in this area.

40967 (ORNL/TM–10971, pp. 148-156) **Factors and strategies in the occupational monitoring of personnel in medical angiography.** Benedict, S.H. (Univ. of California, Los Angeles (USA)); Kleck, J.H.; McLaughlin, J.E. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

Angiographic procedures which include extensive fluoroscopy are among those which can produce the highest radiation exposure of hospital workers. The introduction of hemiaxial projections, and vascular fluoroscopic boost imaging methods has increased diagnostic accuracy, but it has also increased the physician's exposure to scattered radiation. Medical facilities in angiography and catheterization vary in regards to type of equipment and training of personnel. The health physicist for a facility is compelled to initiate a program to measure the potential exposure from a facility as well as assist in the training of personnel to minimize the exposure. Training of the medical personnel also includes techniques of exposure monitoring which for some individuals is more practically attained by utilization of a double badge program. This is especially

important in the university setting where new residents and fellows are being introduced to the facility.

40968 (ORNL/TM–10971, pp. 219-230) **Review of ANSI N13.11: a status report.** Sims, C.S. (Oak Ridge National Laboratory, TN (USA)). Oak Ridge National Lab., TN (USA). Nov 1988. DOE Contract AC05-84OR21400. (CONF-881032–: 2. conference on radiation protection and dosimetry, Orlando, FL (USA), 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

In 1983, the American National Standards Institute (ANSI) issued the dosimetry standard titled Personnel Dosimetry Performance - Criteria for Testing as ANSI N13.11. This standard forms the basis for the National Voluntary Laboratory Accreditation Program (NVLAP) which has become familiar to dosimeter processors in recent years. This standard is particularly important because the Nuclear Regulatory Commission (NRC) requires that all licensees have personnel dosimetry devices processed by processors that are NVLAP accredited. This standard is currently undergoing review and modifications are going to be made. This paper contains a brief history of the events leading to the development of ANSI N13.11-1983, information concerning the present standard and associated performance test results, and the selection of the review group. Following that, the status of the review is presented and statements regarding the future outlook for the standard are made.

40969 (PNL-SA–16858) **Assessing risks from occupational exposure to low-level radiation: The statistician's role.** Gilbert, E.S. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 58p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8906174–1: Conference of the Biometric Society, Davis, CA (USA), 26-28 Jun 1989). Order Number DE89014929/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Currently, several epidemiological studies of workers who have been exposed occupationally to radiation are being conducted. These include workers in the United States, Great Britain, and Canada, involved in the production of both defense materials and nuclear power. A major reason for conducting these studies is to evaluate possible adverse health effects that may have resulted because of the radiation exposure received. The general subject of health effects resulting from low levels of radiation, including these worker studies, has attracted the attention of various news media, and has been the subject of considerable controversy. These studies provide a good illustration of certain other aspects of the statistician's role; namely, communication and adequate subject matter knowledge. A competent technical job is not sufficient if these other aspects are not fulfilled.

40970 (PTB-SE–21) **Radiation exposure of underground workers in the Konrad mine. Assessment and evaluation of exposure due to natural radiation and to radiation from waste stored in the mine.** Ehrlich, D.; Emmermann, H. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. May 1988. 24p. (In German). Order Number DE89794680/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The amount of natural deposits of radionuclides such as K-40, U and Th in the Konrad rock, including their decay products, brings about a rise in the level of radioactivity in mines, an enrichment of the air in mines with Rn and Tn, including their short-lived decay products, as well as an increase of radioactivity content in the dust of respiratory air. A report is presented on measurements of this basic radiological load in the Konrad Mine, which leads to an additional exposure of the underground workers to radiation, as compared to the surface workers. The radiation exposure is determined and evaluated from five different points of view. From the evaluation we can infer i.a. 1. that the Konrad Mine, from a radiological point of view, is classifiable within the value range of 9 comparative non-uranium mines; 2. that on the whole, the limit values stated in the radiation protection ordinance regarding radiation-exposed persons (category A) would not be exceeded, in case of an assumed comparable treatment of natural radiation exposure and of artificial radiation exposure expected to result from ultimate disposal; 3. that the additional risk of cancer resulting from radiation exposure underground is negligible in terms of arithmetical figures. (orig./HP).

40971 (Stralenbescherming–39-B) **Health of plants, animals and ecosystems.** Marwitz, P.A.; Weers, A.W. van; RIVM-Ministerie VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Dec 1988. 78p. (In Dutch). Order Number DE89631215/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Is also related to TRN NL89C0445-NL89C0450.

This report comprises part of a series of eight reports which have been drawn up in behalf of the Dutch Policy Notition Radiation Standards (BNS). It describes subproject 2 entitled 'Health of plants, animals and ecosystems'. The study addresses the following questions: Does application of the radiation-protection principles, intended to the protection of man, offer sufficient protection for populations of plants and animals?; If sufficient protection does exist, are there situations imaginable where adequate protection does not exist?; Should studies be made if the forementioned questions cannot be adequately answered? The gravity of radiation effects depends on the radiation dose to the exposed population. On the base of literature it is concluded that effects upon aquatic and terrestrial populations are excluded below radiation levels of 1 mGy/day. From the application of the generic models it appears that the radiation burden of organisms will remain below 1 mGy/day. Since the radiation burden of man in actual practice will be nearly always be lower certainly no effects upon plants, animals and ecosystems are to be expected. An exception is possible for situations where the exposure does not take place in the living environment of man; in that case protection of man does not limit the radiation levels. Such locations do not exist in the Netherlands. For the Dutch situation, in view of the actual and expected radiation levels, the upper limits derived in the report for the radiation levels will certainly be attained. It is recommended to make estimates for the Netherlands using source terms based upon concrete situations with generic models. (H.W.). 60 refs.; 8 figs.; 3 tabs.

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Refer also to citation(s) 40575, 40614, 40860

40972 (CONF-880520–, pp. 1-9) **Regression analysis in QSAR: potential pitfalls in modeling polar narcotic phenols.** Moulton, M.P. (Georgia Southern College, Statesboro (USA)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The quantitative structure-activity relationship (QSAR) between toxicity (log BR), monitored as cell population growth, and three molecular descriptors was examined for a series of polar narcotic phenols. The molecular descriptors examined were the log 1-octanol/water partition coefficient (log K_{ow}), the single bond fragment molecular connectivity index ($^1\chi^v$), and the ionization constant (pK_a). The best overall model included only log K_{ow} and pK_a. Several problems associated with interpretation of this QSAR analysis were identified. These included: (1) selection of test compounds based only on their range in log K_{ow} values; (2) failure to adjust the coefficient of determination (r^2) for error degrees of freedom; (3) failure to test the significance of the contribution of additional descriptors to the overall model sum of squares in more complex predictive models.

40973 (CONF-880520–, pp. 11-19) **Simplifying complex QSAR's in toxicity studies with multivariate statistics.** Niemi, G.J. (Environmental Protection Agency, Duluth, MN (USA)); McKim, J.M. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of*

the third international workshop on quantitative structure-activity relationships in environmental toxicology. Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

During the past several decades many quantitative structure-activity relationships (QSAR's) have been derived from relatively small data sets of chemicals in a homologous series and selected empirical observations. An alternative approach is to analyze large data sets consisting of heterogeneous groups of chemicals and to explore QSAR's among these chemicals for generalized patterns of chemical behavior. Exploratory analyses using multivariate statistical procedures in an iterative fashion have traditionally been a neglected tool in the effort to find relationships that can lead to testable hypotheses. Hence, statistical analysis does not need to be a device only to test a hypothesis. Moreover, multivariate statistical analyses can simplify the complex relationships among variables. One of the major reasons for not considering multivariate statistical routines for simplifying complex relationships is a lack of understanding and routine use of these techniques by practicing QSAR scientists. The use of exploratory multivariate statistical techniques for simplifying complex QSAR problems is demonstrated through the use of research data on biodegradation and mode of toxic action.

40974 (CONF-880520–, pp. 21-31) **Basis for log P calculations.** Weininger, D. (Pomona College, Claremont, CA (USA)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The author explains the system of calculation log P (oct/water) by the fragment method, a method first proposed by Rekker in Holland, but enlarged and modified for easy computerization by our group at Pomona College. The mathematical expression merely states that one first breaks the solute structure into fragments (whose hydrophobic character has been evaluated), and adds to the sum of these values the sum of all the correction factors which may be required due to any peculiar arrangement of these fragments in the solute in question. This method calculates, or estimates, hydrophobic values simply from the structure of the solute. Since the octanol/water system had already become well-established as a standard measure of hydrophobicity, we chose to base our calculations on that system.

40975 (CONF-880520–, pp. 33-41) **Computer calculation of pK_a.** Hunter, R.S. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

This paper details the results of on-going research efforts to apply microcomputer technology and chemical class models to calculate the first dissociation constant for organic chemicals. Dissociation constants (pK_a) of chemicals are important in toxicological research. Many toxicity Quantitative Structure Activity Relationship (QSAR) models are developed with pK_a as one of the model parameters. Many times literature values for pK_a are not available for the compounds in a study, thus must be estimated or dropped from the study. A computer program to calculate pK_a for a number of organic chemical classes has been developed and is successful at predicting pK_a of chemicals within these chemical classes.

40976 (CONF-880520–, pp. 43-50) **Physical significance of molecular connectivity.** Dearden, J.C. (Liverpool Polytechnic (England)); Bradburne, S.J.A.; Cronin, M.T.D.; Solanki, P. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Molecular connectivity is a topological index calculated from the atom connections in a molecule. If δ_i and δ_j are then number of non-hydrogen connections made by adjacent atoms i and j, then the first order connectivity index χ is calculated as: $^1\chi_{chi} = \Sigma(\delta_i\delta_j)^{-1/2}$ summed over all bonds in the molecule. Zero order ($^0\chi$) values are obtained by summing the inverse square roots of individual δ values. Second order ($^2\chi$) values are calculated by multiplying δ values across two adjacent bonds, and so on. Values calculated across consecutive bonds are called path (p) connectivities. Third- and fourth-order χ values can also be of the cluster (c) type, fourth-order can also include a combined path and cluster (pc), and rings give rise to chain (ch) χ values. The χ index enables one to distinguish between, for example, isomeric structures. Thus pentane has $^1\chi = 2.414$ and isopentane has $^1\chi = 2.269$.

40977 (CONF-880520–, pp. 51-60) **Assessment of toxicity of substituted benzenes: a knowledge based system approach.** Schultz, T.W. (Univ. of Tennessee, Knoxville (USA)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

A prototype knowledge based system (KBS) has been developed to predict the mechanism of toxic action and relative toxicity of substituted benzenes based on their molecular structure. Predictable modes of toxic action include: (1) narcosis; (2) polar narcosis; (3) respiratory uncoupling; and (4) membrane irritation. Initial data used in a consultation include molecular type and molecular weight. Parameters used in this KBS include: (1) number of substitutions; (2) type of substitutions; and (3) position of substitutions. The narcosis mode of action is correlated with, among others, alkyl and halogen substituted benzenes, nitrobenzenes, and cyanobenzenes. Polar narcosis is associated with most phenols, anilines and benzyl alcohols. Uncoupling agents include dinitro-, tetrahalogen-, or pentahalogen-substituted phenols and anilines. Membrane irritation is linked to benzaldehydes and the presence of a carbonyl group.

40978 (CONF-880520–, pp. 61-70) **Fish acute toxicity syndromes: application to the development of mechanism-specific QSARS.** Bradbury, S.P. (Environmental Protection Agency, Duluth, MN (USA)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

In the field of aquatic toxicology a number of groups have proposed and are using predictive models, based on quantitative structure activity relationships (QSARs), as rapid screening tools to identify potentially hazardous chemicals. Several QSARs are now available that predict the acute toxicity of narcotic-industrial chemicals. Predictions for compounds acting through more specific modes of action, which are generally more toxic, require alternative models. Implementation of mechanism-specific quantitative models will require the development of qualitative models that assign the proper mode of action, and respective QSAR, to a given chemical. Current efforts in developing the components of this model are focused on characterizing a toxic mode of action database from which the structural requirements for specific mechanisms can be elucidated. Approaches to defining modes of action include application of joint toxicity theory for chemical mixtures and the assessment of fish acute toxicity syndromes (FATS). FATS are distinct sets of in vivo rainbow trout (Salmo gairdneri) toxic responses that correspond to specific modes of action. By measuring a number of respiratory-cardiovascular variables, response sets associated with nonpolar and polar narcotics, oxidative phosphorylation uncouplers, respiratory membrane irritants, respiratory inhibitors, acetylcholinesterase inhibitors, and central nervous system seizure agents have been described.

40979 (CONF-880520–, pp. 71-80) **QSARs and joint effects for fish LC50 data of unreactive and reactive organic chemicals.** Hermens, J.L.M. (Univ. of Utrecht (Netherlands)); Deneer, J.W. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Fish LC50 data of unreactive organic chemicals are very well correlated with octanol-water partition coefficients (K_{ow}). LC50s of pollutants with a more specific mode of action or chemicals that possess a reactive group, are much lower. Some chemicals react directly while others become reactive only after bioactivation. Depending on the chemical structure, different mechanisms can be distinguished for reactions of chemicals with nucleophilic sites of biologically important macromolecules. QSAR equations for such reactive compounds usually needs an additional descriptor for reactivity. This paper summarizes some general rules for chemical reactivity while specific QSARs are presented for epoxides and aldehydes. In general, LC50s for both types of chemicals are lower than LC50 of unreactive chemicals, although the LC50s of hydrophobic representatives of both classes are very close to predicted LC50s by means of a QSAR for unreactive chemicals.

40980 (CONF-880520–, pp. 81-90) **Structure-activity relationships for the toxicity of organic pollutants to Brachydanio rerio.** Devillers, J. (Institut Pasteur de Lyon (France)); Zakarya, D.; Chastrette, M. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

A set of 45 organic pollutants have been examined in a QSAR study of their acute toxicity (24-h LC50) to Brachydanio rerio (Hamilton-Buchanan). Each compound under study has been described by six components of an autocorrelation vector (LP) based on the octanol-water partition coefficient calculated from a large set of atomic contributions. Different models have been proposed and their predictive power has been discussed. Some remarks concerning the heuristic potency of the autocorrelation vector LP have been made.

40981 (CONF-880520–, pp. 91-98) **Aquatic toxicity of linear alkyl benzene sulphonates (LAS) - a QSAR analysis.** Roberts, D.W. (Unilever Research Port Sunlight Laboratory, Merseyside (England)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

A position-dependent branching factor (PDBF) for calculation of logP (octanol-water) by the Leo and Hansch fragment method is derived from a correlation of goldfish toxicity data for linear alkylbenzene sulphonates (LAS) with, together, LogP calculated in the normal way but without a branch factor and a simple molecular descriptor which varies according to branching position. LogP calculated with the PDBF gives highly linear correlations with data on LAS toxicity to Daphnia and Gammarus pulex, and also with published river sediment LAS sorption data. From the coefficients and intercepts of the toxicity QSARs it is concluded the LAS acts by a non-specific toxicity mechanism of the type believed to apply for chemically unreactive non-electrolytes.

40982 (CONF-880520–, pp. 99-110) **Quantitative structure relationships for predicting toxicity of nitrobenzenes, phenols, anilines, and alkylamines to fathead minnows.** Purdy, R. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Quantitative structure toxicity relationships for fathead minnows were developed for anilines, alkyl amines, phenols, and nitrobenzenes. The toxicity of the anilines and alkyl amines were predicted from log octanol water partition coefficient (log K_{ow}) and the electron density on the amine nitrogen. The toxicity of phenols was predicted from log K_{ow} and one of three other parameters: pKa, electronic charge on phenoxide oxygen, or the lowest unoccupied molecular orbital energy (LUMO). The toxicity of the nitrobenzenes was predicted from log K_{ow}, LUMO, and the square of the lowest absolute nitro nitrogen P_z eigen vector. Mononitroaniline toxicity could be predicted by either the aniline equation or the nitrobenzene equation. Amino or nitrophenol toxicity could only be predicted by the equation for phenols. All equations had R^2 values of 0.89 or greater.

40983 (CONF-880520–, pp. 111-121) **QSAR of the acute toxicity of para-substituted nitrobenzene and aniline derivatives to Photobacterium phosphoreum.** Gough, K.M. (National Water Research Institute, Burlington, Ontario (Canada)); Kaiser, K.L.E. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The acute toxicity values of 4-substituted nitrobenzenes and anilines to Photobacterium phosphoreum are studied in relation to changes in their electronic properties, as predicted from ab initio STO-3G molecular orbital calculations. Other variables considered are their octanol/water partition coefficients, the acute toxicities of the corresponding mono-substituted benzenes, and the Hammett σ_{rho} values. The toxicity of nitrobenzene derivatives is found to depend solely on the change in the charge density at the oxygen atoms of the nitro group, regardless of whether the substituent is electron donating or withdrawing. In contrast, the aniline derivatives must be separated according to substituent type after which a reasonable correlation is obtained with the energy of the highest occupied molecular orbital and the toxicity of the mono-substituted derivative, for electron withdrawing substituents. The only significant variable for the comparatively small set of electron donating substituents in the aniline series was the toxicity of the mono-substituted species.

40984 (CONF-880520–, pp. 123-130) **Structure-toxicity relationships for chemicals causing respiratory uncoupling.** Cajina-Quezada, M. (Univ. of Tennessee, Knoxville (USA)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The relative biological response (log BR) for each of 23 select substituted anilines and phenols was evaluated using the 48-hr Tetrahymena pyriformis test system. Simple linear regression analysis of log BR versus log K_{ow} (1-octanol/water partition coefficient) was used to formulate a quantitative structure activity relationship (QSAR). log BR = 0.456 (log K_{ow}) + 0.114 n = 23, r^2 = 0.934, s = 0.157, f = 294.90. This equation is a highly predictive model for the respiratory uncoupling mode of toxic action. An evaluation of literature date on fish mortality for these compounds shows a similar QSAR. Moreover, the toxic responses in the two systems are highly correlated.

40985 (CONF-880520–, pp. 131-146) **Linear solvation energy relationships for toxicity of selected organic chemicals to Daphnia pulex and Daphnia magna.** Passino, D.R.M. (Fish and Wildlife Service, Ann Arbor, MI (USA)); Hickey, J.P.; Frank, A.M. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third*

international workshop on quantitative structure-activity relationships in environmental toxicology. Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

In the Laurentian Great Lakes, more than 300 contaminants have been identified in fish, other biota, water, and sediment. Current hazard assessment of these chemicals by the National Fisheries Research Center-Great Lakes is based on their toxicity, occurrence in the environment, and source. Although scientists at the Center have tested over 70 chemicals with the crustacean Daphnia pulex, the number of experimental data needed to screen the huge array of chemicals in the Great Lakes exceeds the practical capabilities of conducting bioassays. This limitation can be partly circumvented, however, by using mathematical models based on quantitative structure-activity relationships (QSAR) to provide rapid, inexpensive estimates of toxicity. Many properties of chemicals, including toxicity, bioaccumulation and water solubility are well correlated and can be predicted by equations of the generalized linear solvation energy relationships. (LSER). The equation we used to model solute toxicity is presented.

40986 (CONF-880520–, pp. 147-155) **Structure-activity relationships for diamineplatinum (II) complexes as regards antitumor activity and toxicity.** Hoeschele, J.D. (Warner-Lambert Co., Ann Arbor, MI (USA)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Correlations of chemical structure with antitumor activity/toxicity and with other physicochemical properties are reviewed for cisplatin analogs. These analogs have the common generalized structure, cis-MA_2X_2, wherein M=Pd(II), Pt(II), A_2 and X_2 = two monodentate and/or one bidentate neutral amine and anionic ligand(s), respectively. The following general summary statements are illustrated using antitumor data: (1) only cis complexes are active; trans complexes are inactive, (2) the intrinsic nature of the metal system is a primary determinant of activity, (3) active complexes fall within a window of lability, (4) only neutral complexes exhibit appreciable activity, and (5) the amine group(s) have a primary influence on antitumor activity.

40987 (CONF-880520–, pp. 157-164) **Structure-activity relationships in developmental toxicology.** Kavlock, R.J. (Environmental Protection Agency, Research Triangle Park, NC (USA)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

As in other related disciplines, researchers in developmental toxicology have pursued the goal of defining structure-activity relationships within chemical classes. Due to the inherent complexity of developmental processes, however, it has often been difficult to find significant and predictive relationships between biological activity and chemical structure in the area. This review covers four examples of such efforts. Each approached the problem with different levels of experimental or statistical sophistication. Finally, comments are provided on how future research efforts may be constructed to improve the probability of overall success.

40988 (CONF-880520–, pp. 165-168) **Quantitative structure-activity relationships for alkylated and/or halogenated phenols eliciting the polar narcosis mechanism of toxic action.** Baker, L.L. (Univ. of Tennessee, Knoxville (USA)); Wesley, S.K.; Schuitz, T.W. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

It is the purpose of the present study to determine the relative toxicity of a series of 50 alkyl- and/or halogen-substituted phenols, each representing the polar narcosis mode of action, and examine correlations between the log K_{ow} and pK_a parameters, and toxicity. Tetrahymena pyriformis under a static regime was the toxicity test system used. This sublethal assay used population densities of axenic cultures as its end point. The test compounds selected form a series of mono, di or tri alkyl- and/or halogen substituted phenols. This series was selected because it provides a large selection of commercially available phenolic derivatives each with similar substituents. Additionally toxicity is thought to be via a single mode of action, polar narcosis.

40989 (CONF-880520–, pp. 169-172) **Comparative toxicity of selected anilines, pyridines and nitrobenzenes in the Tetrahymena pyriformis and Pimephales promelas test systems.** Dawson, D.A. (Univ. of Tennessee, Knoxville (USA)); Lin, D.T.; Schultz, T.W. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Several investigators have used a number of test systems to determine the relative toxicity of various industrial organic chemicals in efforts to generate data sets with which to explore quantitative relationships between chemical structure and biological activity, QSARs. Work in our laboratory has involved evaluating the relative toxicity of an extensive series of aromatic chemicals using axenic cultures of the common freshwater ciliate Tetrahymena pyriformis to determine mean population growth impairment concentrations at 48-h followed by similar development of log K_{ow}-dependent QSARs. The present study was undertaken to further examine the extend of the correlation between the toxic response to aromatic chemicals in Tetrahymena pyriformis and Pimephales promelas test systems.

40990 (CONF-880520–, pp. 173) **Determination of octanol/water partition coefficients of hydrophobic chemicals using a slow stirring method.** de Bruijn, J. (Univ. of Utrecht (Netherlands)); Hermens, J. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

In this paper some research is presented on the usefulness of the slow stirring method, described by Brooke et al. (1) for the determination of octanol/water partition coefficients of hydrophobic organic chemicals. The results on 70 compounds including chlorobenzenes, chloroanilines, polychlorobiphenyls (PCBs) and organochlorine pesticides, show that with this method very high partition coefficients can be obtained relatively easily, and with high reproducibility (2). For all 70 compounds tested, standard deviations were lower than 0.07 log-units. Measured values on octa- and decachlorobiphenyl are among the highest ever reported from a direct two-phase system.

40991 (CONF-880520–, pp. 175-178) **Extrapolation of metal-ion toxicities across species to man.** England, M.W. (Oak Ridge National Laboratory, TN (USA)); Turner, J.E.; Jacobson, K.B. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. DOE Contract AC05-84OR21400. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The aim of this study is to extrapolate metal-ion toxicity data across biological species to man. To do this we attempted to get indicators of toxicity at several different levels of biological complexity. For a given indicator to be included, the values for all metal ions had to be obtained under the same conditions. Furthermore, the indicator needed to be expressed in terms of molar values that produce a given biological response. Lastly, a set of data needed to

contain precise values (not less than or greater than values) for a reasonably high number of the 24 metal ions used by Williams et al. (1982). These requirements resulted in the exclusion of much of the toxicity data available in the literature. Data which were found to satisfy the above requirements are included.

40992 (CONF-880520–, pp. 179) **Topological shape and electronic descriptors and their correlation with toxicity to Photobacterium phosphoreum.** Gombar, V.K. (Health Designs Inc., Rochester, NY (USA)); Enslein, K. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Toxicity of 48 substituted benzenes, comprising chlorophenols, benzenes and anilines, to Photobacterium phosphoreum in the Microtox test has been analyzed for quantitative structure toxicity relationships (QSTR). The continuous structure descriptors employed for this study include shape indices, ^{m}K, effective polarisability, δ, and sigma atomic charges, σ. All these quantifiers encoding shape, size and electronic attributes of a molecule are calculated from its adjacency matrix rather than geometry of minimum energy conformation.

40993 (CONF-880520–, pp. 181-183) **Classification of molecular descriptors: calculation of molecular volume and electronegativity from valence electron numbers.** Govers, H. (Free Univ., Amsterdam (Netherlands)); de Voogt, P. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The number of molecular descriptors used in QSAR studies increases rapidly while their definitions, similarities and dissimilarities are often obscure. A systematic classification of descriptors forms a first condition for the sanitation which is felt to be necessary in this field. Along with this classification an integrating theory has to be developed, which incorporates essential findings of well accepted theories like quantum mechanics, statistical thermodynamics, reaction kinetic theory, (non-)equilibrium thermodynamics and graph theory. It is thought to be necessary to start this theory at the level of electrons. Here we present a preliminary classification outline and the perspectives of a simple electron descriptor for the prediction of some frequently used structure and energy related descriptors.

40994 (CONF-880520–, pp. 185-187) **Conformational analysis of the ribodinucleoside monophosphate QpC and interactions of GpC with Cd^{2+}.** Hingerty, B.E. (Oak Ridge National Laboratory, TN (USA)); Figueroa, S.; Hayden, T.L. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. DOE Contract AC05-84OR21400. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Semi-empirical potential energy calculations (molecular mechanics) have been done for the ribodinucleoside monophosphate QpC containing the hypermodified base queuine (Q), which is known to be present in certain species of tRNA and other RNAs. An extensive conformational search was performed employing over 1000 starting conformations using a combinational approach to the number of possible backbone angles. The tetranucleotide (UpQpUpA) containing Q in the anticodon loop of Q(+)tRNA has also been computed. The sequence (ApUpA) represents the anticodon loop of $tRNA^{Tyr}$ of E. coli. Additional calculations for Cd^{2+} binding to GpC, were also done. It has been shown that Cd^{2+} causes Q(-)tRNAs not to be separated from Q(+)tRNAs using RPC-5 column chromatography. In particular the ratio of Q+(tRNA) to Q-(tRNA) changes markedly by including Cd^{2+} in the diet of Drosophila larvae. Since protein synthesis was not affected, this observation appears related to interactions with nucleic acids. Implications for Cd^{2+} toxicity are also noted.

40995 (CONF-880520–, pp. 189-191) **Toxicological databases and reports supporting quantitative structure analysis relationships in environmental toxicology.** Lu, P.Y. Miller, I.C. (Oak Ridge National Laboratory, TN (USA)); Wassom, J.S.; Francis, M.W.; Ross, R.H. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. DOE Contract AC05-84OR21400. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Toxicology information is a rapidly expanding scientific discipline, evolving from the study of chemical contamination of living organisms and the environment. Voluminous experimental data and factual observations have been reported in the open literature, private correspondence, and in fugitive literature, such as government and industry reports only available in limited circulation. This literature is collected and analyzed by the technical information professionals at the Oak Ridge National Laboratory (ORNL) who then organize pertinent data into high quality databases and/or assessment reports to facilitate decision making. The Chemical Hazard Evaluation Program at ORNL is involved in the preparation of factual, peer reviewed toxicological databases. Among these are the Hazardous Substances Data Bank (HSDB) and the Martin Marietta Material Safety Data Sheet (MSDS) file. HSDB is built in collaboration with the National Library of Medicine (NLM). The Environmental Mutagen, Carcinogen, and Teratogen Information Program of ORNL, is responsible for the U.S. EPA Gene-Tox (Genetic Toxicology) Data File.

40996 (CONF-880520–, pp. 193-195) **Preliminary study correlating ionization potentials of aromatic hydrocarbons with their topological indices.** Murray, W.J. (Univ. of Nebraska Medical Center, Omaha (USA)); Markin, R.S.; Cavalieri, E.; Rogan, E. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The ability of aromatic hydrocarbons to bind to DNA is related to their ionization potential (IP) and the ease with which they undergo one-electron oxidation. The IP values of a series of some 90 aromatic hydrocarbons were obtained from three experimental procedures: charge-transfer complexation using chloranil; electronic absorption and polarographic oxidation. The largest experimental group was chloranil complexation, and these data were used for this study. Various methods have been devised that reduce structure to a number, or topological index. In general, these methods apply concepts derived from graph theory in which constituent atoms of a molecule are represented as the vertices or nodes of a graph and bonds between atoms are edges. Two such topological methods are: molecular connectivity and the graph theoretical approach. Topological indices can be used as a quantitative descriptor of molecular structure. As such, they have been used to correlate structure, as encoded in the number(s), with a property, either a physical property or a biological property. This study compares the ability of two topological approaches to correlate the structure of a series of polycyclic aromatic hydrocarbons with their ionization potentials.

40997 (CONF-880520–, pp. 197-200) **Use of 2,2,4-trimethylpentane/water and octan-1-ol/water partition coefficients in QSAR's in environmental toxicology.** Opperhuizen, A. (Univ. of Amsterdam (Netherlands)); Commandeur, T.L.C.M.; Steen, J.M.D.v.d. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of*

the third international workshop on quantitative structure-activity relationships in environmental toxicology. Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

The choice whether to use the partition coefficient of a chemical between water and octan-1-ol or any other organic solvent may significantly influence QSAR's in environmental toxicology. Octan-1-ol/water partition coefficients often correlate well with toxicity parameters, such as fish LC-50 values. However, if various classes of chemicals are investigated, significant differences are usually found between the different QSAR's. The statistical significance of QSAR's normally also decreases if different types of chemicals are investigated in one study. These observations are usually explained as being the result of different modes of action of the chemicals. In the present study it is argued that such explanations may be misleading. This follows from the fact that the differences between the slopes and intercepts of QSAR's for different classes of chemicals are influenced significantly by the use of octan-1-ol/water partition coefficients as the denominator of the chemicals' physical chemical properties. For several chlorobenzenes and chloroanilines experimental octan-1-ol/water and 2,2,4-trimethylpentane/water partition coefficients are determined with a stirring-method.

40998 (CONF-880520–, pp. 201) **Acute toxicity and behavioral effects of acrylates and methacrylates to juvenile fathead minnows.** Russom, C.L. (Environmental Protection Agency, Duluth, MN (USA)); Drummond, R.A.; Hoffman, A.D. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Acrylate and methacrylate esters are reactive monomers that are used primarily in the synthesis of acrylic plastics and polymers. Ninety-six hour flow-through acute toxicity tests were conducted with fathead minnows (Pimephales promelas) using 6 acrylates and 6 methacrylates. Ninety-six hour LC50 values were calculated and then compared to a previously reported structure activity relationship (SAR) for ester narcosis. In addition, behavioral and morphological changes were recorded using a previously developed checklist and were then evaluated using discriminant function analysis.

40999 (CONF-880520–, pp. 203) **QSAR of acute toxicity of commercial chemicals on fathead minnows: effect of molecular size.** Sabljic, A. (Institute Ruder Boskovic, Croatia (Yugoslavia)). Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

This study was undertaken to test the ability of the molecular connectivity model to predict the acute toxicity of alcohols, ethers, aldehydes, ketones, nitriles, aliphatic and aromatic amines, halogenated hydrocarbons, substituted benzenes, and phenols for fish. We obtained good linear correlation between the valence zero-order molecular connectivity index ($^0\chi^v$) and 96 hours LC_{50} data for a large group of commercial chemicals. Our results and their comparison with previously published models demonstrate that the molecular connectivity model is accurate predictive tool for the acute toxicity of a wide range of commercial chemicals and that it can be confidently used to rank potentially hazardous chemicals and to create priority testing list. In addition, it is shown that the molecular size is the most important structural feature that accounts for 85% of the variation in the measured fish acute toxicity data. Finally, an attempt was mode to critically evaluate and compare all published QSAR models for predicting acute toxicity for fish.

41000 (CONF-880520–, pp. 205) **Quantum chemical parameters for the QSAR description of the acute fish toxicity.** Schueuermann, G. (Fraunhofer-Institut fuer Umweltchemie and Oekotoxikologie, Schmallenberg-Grafschaft (Germany, F.R.)); Klein, W. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

In the present study the 14-day LC_{50} toxicity of 10 organophosphorus compounds to guppy is analyzed with respect to quantum chemical descriptors which are designed to model the reactivity of chemicals towards a nucleophilic attack. The results show that the Superdelocalizability S^N_r and the Electronegativity EN as calculated within the MNDO scheme lead to QSAR equations $\log 1/LC_{50} = a \cdot \log P_{ow} + b \cdot x + c$ (x = Quantum Chemical Descriptor) which are of a similar quality as Hermens' QSAR using $\log P_{ow}$ and the experimentally determined alkylation rate constant with 4-Nitrobenzylpyridine as nucleophile. This example shows that quantum chemical parameters have a particular value in modeling chemical reactivity which is especially useful for QSARs based on theoretically derived descriptors.

41001 (CONF-880520–, pp. 211-213) **Partition coefficients and fish toxicity of monochloramines and free residual halogens in chlorinated water.** Tsai, S.C. (Science Applications International Corporation, Oak Ridge, TN (USA)); Mattice, J.S. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

To predict the toxicity of total residual chlorine (TRC) in various kinds of water, we established Quantitative Structure-Activity Relationships (QSAR) between the toxicity and the partition coefficient (PC) of 12 halogen oxidants. The QSAR models developed from these single compounds were further validated with the TRC in three kinds of chlorinated natural water. This study suggests that the mean lipophilicity of chlorine oxidants in a complex mixture of TRC provides a reasonable estimate of the potential toxicity of that effluent. In this study, lipophilicity and fish toxicity of halogen oxidants were determined at pH 8.5 in an aqueous test medium and QSARs were established for a series of residual halogen oxidants, including inorganic monochloramine, free residual chlorine, free residual bromine, and nine aliphatic monochloramines. LC50 values were determined with mosquitofish (Gambusia affinis) exposed to TRC in a flow-through system for one hour.

41002 (CONF-880520–, pp. 215) **Correlations between pairs of physicochemical parameters of metal ions and acute toxicity in mice.** Turner, J.E. (Oak Ridge National Laboratory, TN (USA)); England, M.W.; Hingerty, B.E.; Hayden, T.L. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Jun 1988. DOE Contract AC05-84OR21400. From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN (USA); 22-26 May 1988. In *Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.* Order Number DE88013180/JAW. Available from NTIS, PC A10/MF A01.

Our earlier study of correlations between single physical parameters characterizing divalent metal ions and their acute toxicity in mice is extended to linear combinations of pairs of parameters chosen from among the following five: ionic radius, sum of ionization potentials, atomic weight, Williams softness parameter, and electronegativity. As expected, for a given set of metal ions, equal or better correlations are obtained with the use of an additional parameter. This result is in contrast to findings obtained previously by using scaled parameters. In the present study it is found that the single parameter with the largest correlation coefficient is not necessarily one of the pair that gives the best correlation when two parameters are used. The usefulness of considering metal ions in the groups defined by Kaiser on physical grounds is confirmed, and the results of our analyses are compared with results obtained by him using different parameters.

41003 (CONF-8907113–1) **Mouse models for understanding human developmental anomalies.** Generoso, W.M. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by U.S. DOE Energy

Research. DOE Contract AC05-84OR21400. From 5. international conference on environmental mutagens; Cleveland, OH (USA); 10-15 Jul 1989. Order Number DE89015073/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The mouse experimental system presents an opportunity for studying the nature of the underlying mutagenic damage and the molecular pathogenesis of this class of anomalies by virtue of the accessibility of the zygote and its descendant blastomeres. Such studies could contribute to the understanding of the etiology of certain sporadic but common human malformations. The vulnerability of the zygotes to mutagens as demonstrated in the studies described in this report should be a major consideration in chemical safety evaluation. It raises questions regarding the danger to human zygotes when the mother is exposed to drugs and environmental chemicals.

41004 (ETDE-mf–9794743) **Investigation of the heavy metal load in the Oker ecosystem. Final report.** Rueppell, G. Technische Univ. Braunschweig (Germany, F.R.). Zoologisches Inst. [1988]. 9p. (In German). Contract BMFT 03E-6132-A. Order Number DE89794743/JAW. Available from NTIS (US Sales Only), PC A02/MF A01; NTIS (US Sales Only), PC A02/MF A01.

The research project of the working group is part of an investigation into the heavy metal load (cadmium, lead, zinc and copper) of selected organism groups of the Oker valley. The spatial and temporal distribution of selected primary consumers and consumers of higher order of the river and adjacent river valley areas (macro invertebrates, aquatic birds and small mammals) was determined, their heavy metal content analysed and evaluated. In this report, the results of the individual zoological investigations are summarized. The areas of investigation, material and methods were already dealt with in the 2nd interim report. (orig./MG).

41005 (ETDE-mf–9794746) **Reduction of lead concentrations in milk cows from the area of the former lead mining district Mechernich by means of straw mix as a main forage.** Prang, N. Bonn Univ. (Germany, F.R.). Landwirtschaftliche Fakultaet. 23 Apr 1987. 117p. (In German). Order Number DE89794746/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Long-term tests with straw mix alone or combined with farm-produced basic rations were carried out in immission areas during the search for possibilities for reducing the lead contamination of milk cows. Straw mix consists of 56% of straw, 26% of molasses and 18% of supplementary feed and has, due to production, very low lead contents in comparison to all other farm-produced basic rations. Straw mix as the only basic ration is therefore the safest solution at lead contaminated sites. In dependence on the quantity of straw mix used and the lead contents of the other farm-produced basic ration, the lead contamination of the milk cows could be lowered to about 60 mg per animal and day. (ECB).

41006 (ETDE-mf–9794747) **Studies on uptake, distribution and retention of the heavy metals lead and cadmium, their interaction, and their effects on the concentrations of iron, copper, zink, and calcium in the tissues of fattening calves with regard to aspects of food hygiene or clinical aspects.** Koberstein, S. Giessen Univ. (Germany, F.R.). Fachbereich Veterinaermedizin und Tierzucht. 2 Nov 1987. 299p. (In German). Order Number DE89794747/JAW. Available from NTIS (US Sales Only), PC A13/MF A01; NTIS (US Sales Only), PC A13/MF A01.

The absorption, distribution and retention of the heavy metals lead and cadmium as well as their mutual influence and their effects on the iron, copper, zinc and calcium contents in the tissues of fat calves were investigated under food-hygienic and clinical aspects. The highest retention ratios of Pb and Cd were detected in the kidneys, followed by the livers, lungs, spleens and musculature of the animals. In the caudal vertebrae, where the highest values for Pb absorption were detected, however, only very low Cd concentrations were found. By doubling the normal Ca content in the fodder, the Pb retention in the livers was reduced by 37%, in the kidneys by 74%. Effects on the Cd retention could not be proved. Significant changes in the investigated tissues between their Pb and Cd contents and the Fe, Cu, Zn, and Ca contents determined therein could not be noticed. Damage to the health of the animals caused by the administered quantities of Pb and Cd were not observed. The administration of the maximum quantity of Pb permitted according to the Feed Ordinance on Pb in onefeed rations, and administration of the permissible maximum quantity of Cd being under discussion, even after a reduction in the fodder down to 1/10 of the contents, led to values largely exceeding the 1986 ZEBS guide values. (ECB).

41007 (ETDE-mf–9794750) **Lead concentration in human bones. An investigation of bone specimens taken from the petrosal bone, iliac crest, and femur of 82 test persons between 0-20 years of age, from the Munich and southern Bavarian area.** Ott, J. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin. 24 Nov 1987. 87p. (In German). Order Number DE89794750/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01.

Thus were the following results: the lead concentration in bones increases with age. The highest average lead concentrations were found in the petrosal bone, the second highest in the femur. The iliac crest contains the lowest concentrations. The differences in concentration between the individual bones are small for infants and babies but increase with age. As regards the lead content, the bones of the male and female individuals differ significantly only in the iliac crests of the 10 to 20 year-olds. The lead concentration of the urban population was generally higher than that of the rural population, however, without significant differences. The infants having died of SIDS do not significantly differ from the others. The calculated load on the skeletons caused by lead amounted to 0.181 mg for infants, 0.912 mg for babies and 5.2 mg for adolescents. (orig./MG).

41008 (LA–11624-MS) **Preliminary toxicological study of methyl 2-[hydroxymethyl] acrylate.** London, J.E. Los Alamos National Lab., NM (USA). Aug 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. Order Number DE89015738/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The calculated acute LD 30/50 (lethal dose for 50% of the animals within 30 days after compound administration) value for methyl 2- [hydroxymethyl] acrylate was 762 mg/kg for rats and 723 mg/kg for mice. According to classical guidelines, this compound would be considered slightly to moderately toxic for rats and mice. The eye study in rabbits demonstrated the compound to be an irritant. The sensitization study in guinea pigs did not show the material to have potential sensitizing properties. Skin application studies in rabbits demonstrated the material was lethal for five of six rabbits treated. 5 refs., 3 tabs.

41009 (PNL-SA–17126) **Relative sensitivity and cost of amphipod bioassays.** Word, J.Q.; Ward, J.A.; Brown, B.; Walls, B.D.; Lemlich, S. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 25p. Sponsored by DOD;DOE/NE. DOE Contract AC06-76RL01830. (CONF-8907104–2: 6. symposium on coastal and ocean management, Charleston, SC (USA), 11-14 Jul 1989). Order Number DE89015837/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Studies were conducted to compare the relative sensitivity of the amphipods Ampelisca abdita, Grandidierella japonica, and Rhepoxynius abronius; the differences in their sensitivity under flow-through and static testing protocols; and the relative cost of performing each type of test. These studies, sponsored by the US Army Corps of Engineers (USACE), provided a way of assessing the most cost effective and sensitive way of evaluating sediments proposed for dredging. Sensitivity of R. abronius and A. abdita was evaluated at 51 sites during three separate experimental periods. G. japonica sensitivity was compared to R. abronius and A. abdita at five sites. During each of the three testing periods, flow-through and static testing protocols were evaluated for each species. R. abronius showed greater mortality, and thus higher sensitivity, over the 10-d testing periods than G. japonica or A. abdita. The highest mortality was in the flow-through protocol for R. abronius. We believe this increased sensitivity was due to additional contaminant exposure from the undisturbed air-water interface. The containment loads in the air-water interface of the static jar may not have been as concentrated because of disturbance from aeration. The static protocols were less expensive than flow-through. The testing protocols for R. abronius were less expensive than those for G. japonica. The A. abdita

flow-through test was the most expensive at 2.3 times the cost of the least expensive static R. abronius test. 5 refs., 3 figs., 5 tabs.

41010 (UBA-FB–86-069) **Mussels (Mytilus edulis L.) in coastal water quality control.** Fischer, H. Institut fuer Meereskunde an der Univ. Kiel (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.). May 1986. 57p. (In German). Contract UFOPLAN-Nr. 10607033. Order Number DE89794682/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

With respect to the use of bioindicators for environmental pollution, the causes of the natural variability of heavy-metal concentration in mussels were studied. Natural variability is eliminated by relating Cd quantities concentrated in the soft body to shell weight (Cd/shell weight index). Temperature and dissolved oxygen have no effect on this new measured value. Due, however, to its noticeable affinity to cadmium as compared to calcium, the Cd/shell weight index rises as salinity decreases. A relation to shell weight can be established for Pb and Hg, but not for Cu, for which the weight of the soft body is more suitable as a reference value. Substances revealing a concentration in molluscs relatively independent of their environmental concentration (e.g. Zn) hamper bioindication. The new method is only applicable under certain conditions. The growth of mussels even in the biotope and the relation of proportionately enriched, cumulative substances to shell weight constitute important elements of future monitoring routines using mussels as indicators. (ECB) With 84 refs., 5 tabs., 9 figs.

41011 (UCRL–101200) **Recommended combat drinking water standards for organophosphorus nerve agents.** Daniels, J.I.; Schaub, S.A. Lawrence Livermore National Lab., CA (USA). Jun 1989. 4p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890887–1: Medical defense bioscience review, Columbia, MD (USA), 15-17 Aug 1989). Order Number DE89014178/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Organophosphorus (OP) nerve agents may be used on an integrated battlefield and US Army preventive medicine and quartermaster personnel are required to ensure the safety of drinking water supplies in such combat situations. We developed improved drinking water standards for OP nerve agents, recommending interim drinking water standards for OP nerve agents for consumption rates of 5 and 15 L/d and exposure periods lasting up to seven days. The relationship between pharmacokinetic parameters and toxic responses were established for OP nerve agents for the oral route of exposure only and soman (GD) and VX were identified as being the OP nerve agents of most concern in field-drinking-water supplies. Inhibition of red blood cell cholinesterase (RBC-ChE) was linked to the potential for performance degradation, however, actual toxicological interactions probably occur at cholinergic synapses (i.e., junctions between nerves or nerves and muscles), which cannot be monitored in vivo. In the absence of prophylactic pretreatment with substances such as carbamates, the recommended standards correspond to 50% inhibition of RBC-ChE and are 12 and 4 μg/L for 5 and 15 L/d consumption rates, respectively. If prophylactic pretreatment with a carbamate is used, then RBC-ChE will be inhibited prior to exposure, and the recommended standards correspond to 20% inhibition of RBC-ChE, which correspond to 4.7 and 1.6 μg/L for 5 and 15 L/d consumption rates, respectively. 12 refs.

41012 (UCRL–101505) **Use of an antikinetochore antibody to discriminate between micronuclei induced by aneuploidogens and clastogens.** Tucker, J.D.; Eastmond, D.A. Lawrence Livermore National Lab., CA (USA). 11 Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8907113–3: 5. international conference on environmental mutagens, Cleveland, OH (USA), 10-15 Jul 1989). Order Number DE89015331/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Investigators have reported using antikinetochore antibodies to demonstrate the presence of kinetochores in micronuclei. This approach has also been combined with the cytokinesis-block method to develop a rapid in vitro assay for aneuploidy, which has been shown to work very well in both human lymphocytes and Chinese hamster ovary (CHO) cells. The assay is based upon the assumption that a kinetochore-positive micronucleus contains the centromere and presumably the entire chromosome, while kinetochore-negative micronuclei, regardless of their size, contain only chromosome fragments. In this paper we examine in more detail the micronuclei contained in the cells we reported on previously. The fraction of kinetochore-positive and -negative micronuclei are shown to reflect the mechanism of action for various agents tested in human peripheral lymphocytes and CHO cells.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 40161, 40928

41013 (CRIE–T-87102) **Study of active noise control in ducts.** Nakao, Yoshiatsu. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 27p. (In Japanese). Order Number DE89772353/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

On an active control to reduce noise in ducts, the theoretical and experimental studies of the energies ratio of the noise and the cancelling sound which should be produced by a speaker, were carried out. In case the cancelling sound was produced by the speaker which was set in the branch duct, the energies ratio varied with the setting position, the length and the cross section of the branch duct and the frequency of the noise. As the non-dimensional length of the branch duct was drawing near 0.5, the energies ratio became small. But when the non-dimensional length was 0, the ratio did not become smaller than 1. The experimental test confirmed that it was possible to reduce the noise by the cancelling sound which energies ratio was as small as about one hundredth of the noise. In case the noise was the pure sound, and the wave-length was over one fourth of the duct diameter, it was possible to reduce the noise more than 40 dB. And in case the wave-length was one eighth the reduction quantity was about 20 dB. Therefore, in case the noise is the pure sound or close to the pure sound, it is possible to apply the active noise control. 5 references, 23 figures.

41014 (CRIE–T-87115) **Experimental study on laser breakdown of small-core-size optical fibers.** Kurono, Masahiro; Kurihara, Masayuki; Hirata, Yuichi; Takaso, Seiichi. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 23p. (In Japanese). Order Number DE89760378/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

For the purpose of transmitting the optical power, by the small core size optical fibers in a wide use for the optical communication, an experimental study of the laser breakdown, the graded index (GI) type optical fibers being centralized, was made. The input of YAG laser pulse to the GI type optical fiber resulted in an occurrence of damage. The observation by interference microscope on the damaged optical fiber shows a breakdown at the input end of optical fiber, with damage surfaces complicated in forming, starting at the core center. If the photoelectric field intensity at the time of breakdown, by obtaining the refractive index distribution of laser pulse in the core, by the interference fringe picture of optical fiber, is assumed, it comes to resemble that of the electric field of glass' insulation breakdown, which regards the breakdown to be caused by the electronic avalanche. From the foregoing, in case of transmitting the continuous laser, it can be done without damage upto the output power limit of that laser. While in the case of doing the laser pulse, it can be done by the GI type optical fiber upto the peak output power. The factor to limit the pulse transmission in capacity was known to be the non-linear optical effect and laser breakdown. 12 references, 13 figures, 2 tables.

57 HEALTH AND SAFETY

Refer also to citation(s) 40091

41015 (CEA-DAS–577) **Vulcain N expert fire system.** Roche, A.; Turin, N. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Mar 1989. 9p. (CONF-890203–: IAEA international symposium on fire protection

and fire fighting at nuclear installations, Vienna (Austria), 27 Feb - 3 mar 1989). Order Number DE89903187/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The Institute for Nuclear Safety and Protection (IPSN) has begun work on an expert system to aid in the diagnosis of fire hazards in nuclear installations. This system is called Vulcain N and is designed as a support tool for the analyses carried out by the IPSN. Vulcain N, is based on the Vulcain expert system already developed by Bertin for its own needs and incorporates the specific rules and know-how of the IPSN experts. The development of Vulcain N began in October 1986 with the drawing up of the technical specifications, and should be completed by the end of 1988. Vulcain N brings together knowledge from a number of different domains: the locations of the combustible materials, the thermal characteristics of the combustible materials and of the walls of the room, the ventilation conditions and, finally, knowledge of fire experts concerning the development of fire. The latter covers four levels of expert knowledge: standards and their associated calculations, the simplified physics of the fire enabling more precise values to be obtained for the figures given by the standards, the rules and knowledge which enables a certain number of deductions to be made concerning the development of the fire, and a numerical simulation code which can be used to monitor the variation of certain characteristic parameters with time. For a given fire out-break scenario, Vulcain N performs diagnosis of different aspects: development of fire, effect of ventilation, emergency action possibilities, propagation hazards, etc. Owing to its flexibility, it can be used in the analysis of fire hazards to simulate a number of possible scenarios and to very rapidly deduce the essential, predominant factors. It will also be used to assist in drafting emergency procedures for application in facilities with nuclear hazards.

58 GEOSCIENCES

5801 Geology and Hydrology

Refer also to citation(s) 40013, 40014, 40033, 40584, 40585

41016 (FRNC-TH–3464) **Uranium fission track length distribution modelling for retracing chronothermometrical history of minerals.** Rebetez, M. Besancon Univ., 25 (France). 1987. 267p. (In French). Order Number DE89903276/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

Spontaneous fission of uranium 238 isotope contained in certain minerals creates damage zones called latent tracks, that can be etched chemically. The observation of these etched tracks and the measurement of their characteristics using an optical microscope are the basis of several applications in the domain of the earth sciences. First, the determination of their densities permits dating a mineral and establishing uranium mapping of rocks. Second, the measurement of their lengths can be a good source of information for retracing the thermal and tectonic history of the sample. The study of the partial annealing of tracks in apatite appears to be the ideal indicator for the evaluation of petroleum potential of a sedimentary basin. To allow the development of this application, it is necessary to devise a theoretical model of track length distributions. The model which is proposed takes into account the most realistic hypotheses concerning registration, etching and observation of tracks. The characteristics of surface tracks (projected lengths, depths, inclination angles, real lengths) and confined tracks (Track IN Track and Track IN Cleavage) are calculated. Surface tracks and confined tracks are perfectly complementary for chrono-thermometric interpretation of complex geological histories. The method is applied to the case of two samples with different tectonic history, issued from the cretaceous alcalin magmatism from the Pyrenees (Bilbao, Spain). A graphic method of distribution deconvolution is proposed. Finally, the uranium migration, depending on the hydrothermal alteration, is studied on the granite from Auriat (France).

41017 (INIS-mf–11495, pp. 18-20) **Current status of radiocarbon datings.** Polach, H.A. (Australian National Univ., Canberra (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Significant developments to the technology of radiocarbon dating have taken place in the last 10 years. Here we shall review the refinements in gas proportional (GP), liquid scintillation (LS) and accelerator mass spectrometry (AMS) and evaluate the status and significance of these techniques in an Australian Quaternary and environmental research context.

41018 (SAND–89-0087C) **Comparison of in situ stress information from core and log analyses.** Sattler, A.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8908102–1: Society of Core Analysts annual conference, New Orleans, LA (USA), 1-3 Aug 1989). Order Number DE89015841/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Horizontal stress directions (azimuths) determined from anelastic strain recovery (ASR) and differential strain curve analyses (DSCA) were compared with those from wellbore breakouts detected by borehole televiewer and oriented caliper logs. The ASR/DSCA techniques appear to be more sensitive then the log techniques and provided stress azimuth predictions at depth intervals where the log data did not. Stress azimuth determinations were also made from other core analyses techniques, which, like ASR/DSCA, are associated with the formation of stress release microcracks. Preliminary insights were obtained in the applicability of these other techniques. This work provides information on the stresses at two well sites 3.6 miles apart in Western Colorado; and showing the comparative data in this context provides information on how to apply these techniques and provides an understanding of the apparent influence of geologic effects (topography, depositional environment) on the stresses. 28 refs., 10 figs., 3 tabs.

5802 Geophysics

Refer also to citation(s) 41035

41019 (CEA-DAS–532e) **Strong seismic ground motion propagation.** Seale, S.; Archuleta, R.; Pecker, A.; Bouchon, M.; Mohammadioun, G.; Murphy, A.; Mohammadioun, B. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Oct 1988. 10p. (CONF-881014–: International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety, Avignon (France), 2-7 Oct 1988). Available from NTIS (US Sales Only), PC A02/MF A01.

At the McGee Creek, California, site, 3-component strong-motion accelerometers are located at depths of 166 m, 35 m and 0 m. The surface material is glacial moraine, to a depth of 30.5 m, overlying homfels. Accelerations were recorded from two California earthquakes: Round Valley, M_L 5.8, November 23, 1984, 18:08 UTC and Chalfant Valley, M_L 6.4, July 21, 1986, 14:42 UTC. By separating out the SH components of acceleration, we were able to determine the orientations of the downhole instruments. By separating out the SV component of acceleration, we were able to determine the approximate angle of incidence of the signal at 166 m. A constant phase velocity Haskell-Thomson model was applied to generate synthetic SH seismograms at the surface using the accelerations recorded at 166 m. In the frequency band 0.0 - 10.0 Hz, we compared the filtered synthetic records to the filtered surface data. The onset of the SH pulse is clearly seen, as are the reflections from the interface at 30.5 m. The synthetic record closely matches the data in amplitude and phase. The fit between the synthetic accelerogram and the data shows that the seismic amplification at the surface is a result of the contrast of the impedances (shear stiffnesses) of the near surface materials.

41020 (CRIE–U-88016) **Experimental study on radar waves geotomography at granitic area.** Shin, Koichi; Kitano, Koichi; Hori, Yoshinao. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1988. 29p. (In Japanese). Order Number DE89772347/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo.

The objective of this study is to serve the development of deep underground inspection technique. For this purpose, an experiment on the conductivity of radio wave between boreholes which were bored in the granite at Rock Measuring Experiment Field at Makabe, Ibaraki prefecture. As an experimental result, the relationships between the frequency and travel distance in the rock, and some geotomographs painted according to the velocity and attenuation rate of radio waves of 80 MHz and 150 MHz were obtained with the similar correlation. As to the conductivity of radio wave in rock, using aparatus of 90 W, 40 m transmiter-receiver distance for frequency of 80 MHz was attained, and 30 m for 150 MHz, 20 m for 320 MHz 10 m for 500 MHz respectively. As to the results of geotomography analysis, the border of soil and rock was clearly distinguished by the geotomograph of radio wave velocity. It was also made clear that the geotomographs of radio wave velocity and radio wave attenuation rate were not necessarily in conformity with ones of elastic wave velocity and elastic wave attenuation rate. 4 references, 22 figures.

41021 (INIS-mf–11495, pp. 85-87) **Use of natural radioisotopes in studies of volcanic rocks.** Wheller, G.E. (Tasmania Univ., Sandy Bay (Australia)); Varne, R.; Roman, D. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Samples of historical lava flows from ten Indonesian volcanoes have been analysed for U and Th isotopes, and samples collected from Australia's only active volcano, Heard Island in the southern Indian Ocean, and four young volcanoes in southeastern mainland Australia have been analysed. The Heard Island lavas will also be analysed for ^{226}Ra and ^{210}Pb activities. So far, activities of U and Th isotopes have been obtained from the rock samples by isotope dilution alpha spectrometry at Lucas Heights. U and Th were separated from up to 5 g of powdered rock using an anion exchange technique following digestion by HF.^{236}U and^{229}Th were used as isotopic spikes and as chemical yield monitors. In the samples analysed so far, U and Th concentrations range from 0.3 to 6 ppm and from 1 to 32 ppm respectively.

41022 (INIS-mf–11986) **Earthquakes in the Federal Republic of Germany in 1983. Reports of the seismological observatories in the F.R.G. and catalogue of important seismic events worldwide.** Henger, M.; Leydecker, G. Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.). 1988. 56p. (In German). Order Number DE89795009/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The report summarizes the regional reports of the seismological observatories for the year 1983. There was no serious earthquake so far in the F.R.G. The data are presented in the form of maps showing the seismic centers in West Germany (including marginal regions). Explanations of seismological terminology and abbreviations used are given for the general reader. (DG).

5803 Mineralogy, Petrology, and Rock Mechanics

Refer also to citation(s) 39884, 40021

5804 Geochemistry

Refer also to citation(s) 40599, 40675

41023 (MINTEK-M–356) **The distribution of cobalt in mineral constituents of the Merensky Reef and UG-2 Chromitite Layer of the Bushveld Complex.** Smits, G. Council for Mineral Technology, Randburg (South Africa). Mineralogy Div. 6 Jul 1988. 8p. Order Number DE89015031/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

Trace amounts of cobalt are incorporated in almost all the constituents of the Merensky Reef and the UG-2 Chromitite Layer of the Rustenburg Layered Suite in the Bushveld Complex. Although the cobalt concentration in silicates and chromites is low, ranging up to 800 and 700 ppM, respectively, the proportion hosted by these minerals is large because they are the predominant constituents of the rock. In the Merensky Reef, the silicates are major constituents, so the bulk of the cobalt is present in them; in the chromite-rich UG-2 layer, the major proportion is present in chromite. Only the cobalt that is locked up in sulphides can be extracted during beneficiation of the platinum-group minerals and, because the sulphide content of the reefs is very low, the total amount of cobalt that can be recovered is also low. 22 refs., 9 tabs.

5805 Oceanography

41024 (CRIE–U-88013) **Applicabilility of the abosorbing wavemaker system to the irregular wave experiments.** Hirakuchi, Hiromaru; Kajima, Ryoichi. Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). Technical Lab. No. 2. Aug 1988. 52p. Order Number DE89772381/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan.

Application of the absorbing wavemaker system to irregular wave creation is described, and a report is made on the result of the hydraulic experiments to verify the applicability of the system through a comparison with the conventional wave paddle position control system. The relationship of the wavemaking signals input to the wavemaking system and reflected waves with the waves generated by these 2 kinds of input is shown. A concrete way of making irregualr waves with this absorbing wavemaker system which satisfies the object spectrum is introduced. Through the regular and irregular wavemaking experiments, it was confirmed that accurate desired waves can be generated. It was also confirmed that stable desired irregualr waves can be made by this wavemaker system, absorbing reflected waves from structures. The absorbing wavemaker system used in the current study can considerably reduce re-reflection by the wave paddle, and is very effective for irregular wave tests which reguire long term measurements. 9 refernces, 16 figures, 4 tables.

41025 (DOE/ER/60285–6) **Simulation analysis of moored fluorometer time series from the Mid-Atlantic Bight: Progress report, FY 1988–1989.** Walsh, J.J.; Dieterle, D.A.; Gregg, W.W.; Pribble, J.R. University of South Florida, St. Petersburg, FL (USA). Dept. of Marine Science. 1989. 86p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-85ER60285. Order Number DE89015814/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

A two-layered baroclinic circulation model and a 21-layered biochemical model are used to explore the consequences of Loop Current-induced upwelling and terrestrial eutrophication on "new"production within the Gulf of Mexico. During a quasi-annual penetration and eddy-shedding cycle of the Loop Current, the simulated seasonal changes of incident radiation, wind stress, and surface mixed layer depth induce an annual cycle of algal biomass that corresponds to in situ and satellite time series of chlorophyll. The simulated nitrate fields match those of shipboard surveys, while fallout of particulate matter approximates that caught in sediment traps and accumulating in bottom sediments. Assuming an f ratio of 0.06–0.12, the total primary production of the Gulf of Mexico might be 105–210 g C m $^{-}$2 yr^{-}1 in the absence of anthropogenic nutrient loadings, i.e., 2–3 fold that of oligotrophic regions not impacted by western boundary currents. Less than 25% of the nitrogen effluent of the Mississippi River may be stored in bottom sediments, with most of this input dispersed in dissolved form beneath the pycnocline, after remineralization of particulate detritus within several production cycles derived from riverine loading. At a sinking rate of 3 m day $^{-}$1, however, sufficient phytodetritus survives oxidation in the water column to balance estimates of bottom metabolism and burial at the margins.

41026 (DOE/ER/60338–7) **Program of mineralization and cycling in marine systems: Organic geochemistry of particulates and sediments (CaBS): Technical progress report, November 15, 1988–May 14, 1989.** Venkatesan, M.I.; Kaplan, I.R. California Univ., Los Angeles, CA (USA). Inst. of Geophysics and Planetary Physics. Jun 1989. 3p. Sponsored by U.S. DOE Energy Research.

DOE Contract FG05-85ER60338. Order Number DE89015809/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The principal objective of the current on-going project is to understand the processes involved in the cycling of organic carbon in the southern California Bight. This involves the evaluation of the relative flux of planktonic carbon to the seafloor versus the import of terrestrial carbon components and the determination of the rate of decomposition of sedimenting organic matter in the water column. These goals were achieved by the chemical characterization of sedimenting particles (from traps) as well as in the near surface sediments. The organic matter in the marine regime comprises contribution from land plants, marine productivity (plankton and bacteria) as well as anthropogenic sources. At UCLA, we have been focusing on the chemical characterization of selected classes of organic carbon compounds derived from these various sources to understand the vertical flux and the chemical composition of the particulate organic matter which are controlled by complex transport, transformation, degradation and remineralization processes.

64 PHYSICS I

Refer also to citation(s) 40340, 40684

6401 Astrophysics and Cosmology

Refer also to citation(s) 41066

41027 (DOE/ER/03130–49C) **Particle physics discovery potential using dark matter detectors.** Lanou, R.E.; Sadoulet, B. Brown Univ., Providence, RI (USA). Dept. of Physics. 1988. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER03130. (CONF-8806243–43: DPF summer study: Snowmass '88: high energy physics in the 1990s, Snowmass, CO (USA), 27 Jun - 15 jul 1988). Order Number DE89013959/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many of the present directions suggested for going "beyond the Standard Model" show promise for tests utilizing astrophysical sources. Some astrophysical puzzles suggest particle physics solutions requiring new, unconventional particles. In order to capitalize on these opportunities for progress in particle physics new detection techniques are required. Present technology has already permitted some important tests but the technology is near its limit. Intense activity is underway particularly in the area of cryogenic detectors. These developments have created an exciting new frontier at the intersection of condensed matter, astrophysics and particle physics. The nature of this frontier and its implications for progress in particle physics and its complementarity to the SSC potential are emphasized. Examples of dark matter and solar neutrino experiments are used to illustrate. 59 refs., 3 figs., 2 tabs.

41028 (FERMILAB-PUB–89/140-A) **Evolution of cosmic string networks.** Albrecht, A.; Turok, N. Fermi National Accelerator Lab., Batavia, IL (USA). Jun 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (PUPT–89-1133). Order Number DE89015245/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We summarize our new results on cosmic strings. These results include: the application of non-equilibrium statistical mechanics to cosmic string evolution, a simple "one scale" model for the long strings which has a great deal of predictive power, results from large scale numerical simulations, and a discussion of the observational consequences of our results. An upper bond on $G\mu$ of approximately 10^{-7} emerges from the millisecond pulsar gravity wave bound. We discuss how numerical uncertainties affect this. Any changes which weaken the bound would probably also give the long strings the dominant role in producing observational consequences. 22 refs.

41029 (FERMILAB-PUB–89/156-A) **Pair production of helicity-flipped neutrinos in supernovae.** Perez, A.; Gandhi, R. Fermi National Accelerator Lab., Batavia, IL (USA). 3 Jul 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89015244/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We calculate the emissivity for the pair production of helicity-flipped neutrinos, in a way that can be used in supernova calculations. We also present some simple estimates which show that such processes can act as an efficient energy-loss mechanism in the shocked supernova core, and we use this fact to extract neutrino mass limits from SN1987A neutrino observations. 24 refs., 2 figs.

41030 (IFUSP-P–743) **Quantum fields out of thermal equilibrium and the dynamics of inflation.** Eboli, O.J.P. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1988. 8p. (CONF-8806105–: 17. international colloquium on group theoretical methods in physics, St. Adele (Canada), 27 Jun - 2 jul 1988). Order Number DE89632076/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

It is showm the consistency of the coupled Einstein matter, in the Gaussian approximation and justifies the semi-classical approximation where quantum gravity effects are ignored. (M.C.K.).

41031 (LA-UR–89-2381) **Metal multilayer mirrors for EUV wide field telescopes.** Smith, B.W.; Bloch, J.J.; Roussel-Dupre,D. Los Alamos National Lab., NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890836–2: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, San Diego, CA (USA), 6-11 Aug 1989). Order Number DE89015262/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Metal multilayer mirrors have been designed for the ALEXIS satellite, which is to carry six wide field telescopes to perform an all-sky survey in three or four narrow wavelength bands in the EUV. Comprised of alternating layers of molybdenum and silicon, the mirrors are optimized to provide maximum reflectivity at angles from 11.5 to 17° off normal incidence and at wavelengths of 133, 171, or 186A. Simultaneously, the mirrors use a "wavetrap" described below to suppress reflectivity at 304A, where the extremely strong geocoronal line of He II causes severe background problems. Low reflectivity at 304A is achieved by superposing two layer pairs that provide destructive interference with an effective 2d spacing of 152A. The Mo layers in this wavetrap must be very thin, about 10A each, in order to allow the shorter wavelengths desired for peak reflectivity to penetrate without significant attenuation. Because refraction changes the effective angle of passage through the wavetrap, a joint optimization between layer thicknesses in the deep layers and the wavetrap layers must be performed for each target peak wavelength. For the 186A mirror, the optimum design from substrate upward is 40 layer pairs, each 74A Si and 31A Mo, followed by 2 layer pairs, each 55A Si and 10A Mo. Calculations predict this design will have a peak reflectivity at 186A of 35 percent and a 304A reflectivity less than 10^{-5}, if available optical constants are correct and the multilayer can be fabricated without difficulty. We will present details of the calculations and laboratory measurements of the reflectivity performance attained with prototype mirrors. 6 refs., 2 figs.

41032 (LBL–26589) **Horizontal branch stars as a probe of non baryonic dark matter.** Salati, P.; Bouquet, A.; Raffelt, G.; Silk, J. Lawrence Berkeley Lab., CA (USA). Jan 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-881212–2: Particle astrophysics workshop, Berkeley, CA (USA), 8-10 Dec 1988). Order Number DE89015448/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The solar neutrino problem can be interpreted as a signature for the existence and properties of certain dark matter candidate particles ("cosmions"). We investigate the breaking of convection by neutrino-like cosmions in horizontal branch (HB) stars. These particles may affect globular clusters in the inner galaxy or in dwarf spheroidals where the dark matter density is larger than in the solar neighborhood, leading to an observable reduction of the HB lifetime. 10 refs., 1 fig.

41033 (LBL–27293) **Neutron stars, fast pulsars, supernovae and the equation of state of dense matter.** Glendening, N.K. Lawrence Berkeley Lab., CA (USA). 1 Jun 1989. 34p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. (CONF-8905143–6: NATO international advanced courses on the

nuclear equation of state, Peniscola (Spain), 12 May - 3 jun 1989). Order Number DE89015348/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We discuss the prospects for obtaining constraints on the equation of state from astrophysical sources. Neutron star masses although few are known at present, provide a very direct constraint in as much as the connection to the equation of state involves only the assumption that Einstein's general theory of relativity is correct at the macroscopic scale. If the millisecond pulses briefly observed in the remnant of SN1987A can be attributed to uniform rotation of a pulsar, then a very severe constraint is placed on the equation of state. The theory again is very secure. The precise nature of the constraint is not yet understood, but it appears that the equation of state must be neither too soft nor stiff, and it may be that there is information not only on the stiffness of the equation of state but on its shape. Supernovae simulations involve such a plethora of physical processes including those involved in the evolution of the precollapse configuration, not all of them known or understood, that they provide no constraint at the present time. Not even the broad category of mechanism for the explosion is agreed upon (prompt shock, delayed shock, or nuclear explosion). In connection with very fast pulsars, we include some speculations on pure quark matter stars, and on possible scenarios for understanding the disappearance of the fast pulsar in SN1987A. 47 refs., 16 figs., 1 tab.

41034 (RAL–89-022) **Comparison of theoretical and solar-flare intensity ratios for the Fe XIX X-ray lines.** Bhatia, A.K.; Lemen, J.R.; Mason, H.E.; Fawcett, B.C.; Phillips, K.J.H. Rutherford Appleton Lab., Chilton (UK). Apr 1989. 34p. Order Number DE89632037/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Atomic data consisting of energy levels, g f-values and wavelengths are presented for the Fe XIX $2s^2\ 2p^4$-$2s^2\ 2p^3\ 3s$, $2s^2\ 2p^3\ 3d$ arrays that give rise to lines in solar flare and active-region X-ray spectra. Collision strengths and theoretical intensity ratios are given for the $2s^2\ 2p^4$-$2s^2\ 2p^3\ 3d$ lines, which occur in the 13.2-14.3 A range. Solar spectra in this range include a large number of other intense lines, notably those due to He-like Ne (Ne IX). Although the Ne IX lines are potentially the most useful indicators of electron density in solar X-ray spectra, blending with the Fe XIX lines has been a major problem for previous analyses. Comparison of observed spectra with those calculated from the Fe XIX atomic data presented here and Ne IX lines from other work indicates that there is generally good agreement. We use the calculated Fe XIX and Ne IX line spectra and several observed spectra during a flare previously analysed to estimate electron density from Ne IX line ratios, thus for the first time properly taking into account blends with Fe XIX lines. (author).

41035 (UCRL–53809-88) **Institute of Geophysics and Planetary Physics 1988 annual report, July 1, 1987–September 30, 1988.** Alcock, C.R.; Budwine, C.M. (eds.). Lawrence Livermore National Lab., CA (USA). 1 Jul 1989. 102p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014363/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report contains brief summaries on research conducted at the Institute of Geophysics and Planetary Physics on the following topics: Geoscience, High-pressure sciences, and Astrophysics.

41036 (WINCO–1061) **Collapsing ring model of the origin of the solar system.** Schlenker, L.D. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (USA). Dec 1988. 230p. Sponsored by U.S. DOE Energy Research. DOE Contract AC07-84ID12435. Order Number DE89014332/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics on the origin of the solar systems: derivation of candidate angular momentum transfer equations; dust ring identified; classic accretional problems in planetary formation; formation of the outer planets; outer solar system satellites; rock rings; comets; the asteroids; formation of the inner planets; meteoric formation processes; formation of the inner planetary satellites; the moon facilitated life on earth; origin of the sun; and residual evidence of the collapsing ring configuration.

6402 Atmospheric Physics

41037 (PNL-SA–16848) **An anisotropic shadowband correction for parameterized sky conditions and geometry.** LeBaron, B.A.; Michalsky, J.J.; Perez, R. Pacific Northwest Lab., Richland, WA (USA). Mar 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-890610–5: American Solar Energy Society annual meeting, Denver, CO (USA), 19-23 Jun 1989). Order Number DE89014916/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A model is presented that corrects the horizontal diffuse irradiance measured using a polar-axis design shadowband. Ratios of true diffuse to uncorrected diffuse measurements are binned and averaged according to parameters describing the associated geometric screening and current sky conditions. The screening parameter is a geometric calculation for the amount of the sky hemisphere eclipsed by the band. The sky condition parameters account for the anisotropic distribution of the diffuse irradiance across the sky hemisphere. An independent set of uncorrected diffuse data corrected using this parameterization technique has a root mean square error of 6.8 W/m^2 and a regression slope of 0.99. Sine the correction ratios are developed from parameters that are not site specific, the model should be generally applicable. 11 refs., 3 figs., 2 tabs.

41038 (UCID–21595) **Kestrel 2 Program: Final report.** Duke, P.O. Lawrence Livermore National Lab., CA (USA). May 1988. 261p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. Order Number DE89012812/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The Kestrel 2 program began in 1986 as an outgrowth of the original Kestrel program, which used conventional balloon techniques and facilities, and was completed in 1988. It was undertaken to extend operational and geographic flexibility beyond that achievable using traditional techniques observed in the original program. During that time, we developed a tandem-balloon system that can be launched from any single launch site in winds up to 20 knots. We also developed a fast-fill tow balloon, which we tested by filling a tow balloon directly from it shipping container without laying it out on a long clean surface. To test the endurance of the tow balloon, we filled and repackaged the same balloon four times, once while at sea, at a fill rate of 3000 to 4000 ft^3/min, using helium gas. This testing showed that the tow balloon is indeed quite rugged. We also demonstrated how to control the tow balloon with handling lines and rig the balloon in winds up to 26 knots at sea on a small ship. The tandem-balloon deployment system includes a lightweight, high-strength, waterproof payload containment canister and an explosive flight-termination system. The launch release mechanism that we designed was tested at sea. An electronics and power supply system provided tracking and command termination and was used to perform simple command functions.

6403 Atomic, Molecular, and Chemical Physics

Refer also to citation(s) 41253, 41318, 41319

41039 (ANL–88-31, pp. 68, Paper 4) **Fundamental molecular physics and chemistry.** Argonne National Lab., IL (USA). Jul 1988. In *Environmental Research Division technical progress report: January 1986-October 1987.* Order Number DE88016165/JAW. Available from NTIS, PC A12/MF A01.

The research of the Fundamental Molecular Physics and Chemistry Program deals with the properties of molecules that are related to their interactions with photons, electrons, and other charged particles. Specifically, we deal with photons ranging from the visible region to the far-vacuum-violet region, and with electrons of energies ranging from several electron volts to hundreds of electron volts. A major focus of our research is to provide fundamental data needed in radiation research. Another major thrust is to develop methods for detecting and characterizing molecular species, including excited states, radicals, and other unstable species. To this end, resonance-enhanced multiphoton ionization spectroscopy is being developed to elucidate dynamics of electronic excited states. This technique is important in advanced measurement science because of its high sensitivity and selectivity.

41040 (CEA-N–2586) **Kinematical transformations and integration of double differential cross - sections.** Bersillon, O. CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France). 1989. 50p. (In French). Order Number DE89903185/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Nuclear reactions in which the residual nucleus has an excitation energy lying in the continuum region give outgoing particle spectra which can be described by double differential cross-sections, the center-of-mass to laboratory transformation of which involves a particular jacobian. The numerical aspect of this transformation is studied in the particular case of two simple examples. A direct method to get tabulated laboratory cross-sections is also presented.

41041 (CONF-890708–3) **On the utility and ubiquity of atomic collision physics.** Datz, S. Oak Ridge National Lab., TN (USA). 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 16. international conference on the physics of electronic and atomic collisions; New York, NY (USA); 26 Jul - 1 aug 1989. Order Number DE89015356/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is divided into three parts. In the introduction, we discuss the history and makeup of ICPEAC. In the second part, we discuss the extent of applicability of atomic collision physics. In the third part, we chose one subject (dielectronic excitation) to show the interrelationship of various sub-branches of atomic collision physics. 28 refs., 14 figs.

41042 (CONF-890708–4) **Electron correlation in the continuum.** Bottcher, C.; Strayer, M.R. Oak Ridge National Lab., TN (USA). 24 Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 16. international conference on the physics of electronic and atomic collisions; New York, NY (USA); 26 Jul - 1 aug 1989. Order Number DE89015359/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We consider a class of problems, notably double ionization, which require accurate descriptions of correlation in both the initial and final states. Methods are presented for representing correlated wavefunctions on a basis spline lattice, and for calculating bound-continuum transition probabilities. 13 refs.

41043 (CONF-890708–5) **Electron capture and energy-gain spectroscopy.** Taulbjerg, K. Oak Ridge National Lab., TN (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 16. international conference on the physics of electronic and atomic collisions; New York, NY (USA); 26 Jul - 1 aug 1989. Order Number DE89015365/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The applicability of translation energy spectroscopy as a tool to determine individual reaction cross sections in atomic collisions is analyzed with special emphasis on the electron capture process in highly charged ion collisions. A condition is derived to separate between higher collision energies where translation energy spectroscopy is problem free and lower energies where strong overlap of individual spectra features prohibits an analysis of the total translation energy spectrum by means of a simple deconvolution procedure. 8 refs., 6 figs.

41044 (CONF-8905141–3) **Recent advancements in high intensity heavy negative ion sources based on the sputter principle.** Alton, G.D. Oak Ridge National Lab., TN (USA). 1989. 41p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 5. international conference on electrostatic accelerators and associated boosters; Strasbourg (France); 24-27 May 1989. Order Number DE89012503/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Significant advancements have been recently made in the technology of forming high intensity heavy negative ion beams. Due to their ease of operation, simplicity, long lifetime, and wide range of species capabilities, negative ion sources predicated on the sputter principle are being used for an increasing number of diverse applications, including standard tandem accelerator-based research, high-energy ion implantation, tandem accelerator mass spectrometry, and low-energy atomic physics research. Sources have been developed which utilize either direct surface ionization, or a plasma to form the positive ion beam used to effect sputtering of samples containing the material of interest. This article will include a brief review of the fundamental processes underlying negative ion formation in these sources. Emphasis will be placed on the descriptions and performance characteristics of specific sources based on each of the positive ion formation techniques. 21 refs., 16 figs., 1 tab.

41045 (GSI–89-43(prepr.)) **Radiative muon capture in light atoms.** Soff, G.; Rafelski, J. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 11p. Order Number DE89795125/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Total cross sections for radiative nuon capture (RMC) into inner shells of light atoms are evaluated. (orig.).

41046 (GSI–89-46(prepr.)) **Atomic parity violation in U^{90+}.** Schaefer, A; Soff, G.; Indelicato, P.; Mueller, B.; Greiner, W. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 12p. Order Number DE89795130/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Parity mixing of electron states should be extremely strong for helium-like uranium. We calculate its size and discuss whether it could be determined experimentally. We analyse one specific scheme for such an experiment. The required laser intensities for two-photon spectroscopy of the 2^3P_0-2^1S_0 level splitting is of the order of $2x10^{15}$ W/cm^2. A determination of parity mixing would require $4x10^{19}$ W/cm^2 and a very high degree of linear polarization. (orig.).

41047 (INIS-BR–1555) **Measurements of Si, Tl, V, Cu, Zn, Zr and Pd stopping power using ^{14}N and ^{16}O ions.** Vilela, M.M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 95p. (In Portuguese). Order Number DE89631805/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The energy losses of ^{14}N and ^{16}O ions in solids (Si, Ti, V, Cu, Zn, Zr and Pd) at energy range from 1 MeV/amu to 4 MeV/amu were measured. The technique consists in the energy measurement of scattered projectiles at 25^0 by a thin target of Au, before and after to across the foil of breaker element. The experimental results are compared with semi empirical calculations of Northcliffe and Schilling (N and S), Ziegler and a new version of N and S done by Hubert et all, observing a reasonable agreement between the measured values and semi empirical curves. (M.C.K.).

41048 (INIS-SU–98, pp. 97) **Positronium atom production by a superhigh-energy photon in a crystal.** Kunashenko, Yu.P.; Pivovarov, Yu.L. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

POSITRONIUM/photoproduction; COHERENT PRODUCTION; CROSS SECTIONS; CRYSTALS; ELECTRON PAIRS; INCIDENCE ANGLE; LATTICE VIBRATIONS; POSITRONIUM; PHOTOPRODUCTION

41049 (INIS-SU–98, pp. 98) **Deformed positronium atom radiation.** Kunashenko, Yu.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

POSITRONIUM/crystals; POSITRONIUM/electromagnetic radiation; ANGULAR DISTRIBUTION; ANNIHILATION; ELECTRON CHANNELING; INCIDENCE ANGLE; POSITRON CHANNELING; POSITRONIUM; CRYSTALS; PROBABILITY; WAVE FUNCTIONS

41050 (IPNO-DRE–88-19) **Data relative to (e, argon) and (e, ethane) interactions necessary for strong field transport calculations.** Florent, J.J. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 70p. (In French). Order Number DE89903307/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Collisions between electrons and argon atoms and ethane molecules are studied in order to better understand phenomena occurring at each stage of detection in gas detectors used in nuclear and high energy physics. Elastic collisions between an electron and argon, those producing an electronic excitation of the atom, and those leading to its ionisation are reviewed. For the ethane collisions, vibrational excitation is considered. Photoionisation of argon and ethane is also examined. Total or partial cross sections, and differential cross sections are presented.

41051 (SAND–89-0886C) **A curved detection-slit to improve ERD [Elastic Recoil Detection] energy/depth resolution.** Brice, D.K.; Doyle, B.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906161–3: Ion beam analysis conference, Kingston (Canada), 26-30 Jun 1989). Order Number DE89013936/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recoil atoms detected in Elastic Recoil Detection (ERD) experiments emerge from an initial collision area along cones of constant energy due to the cylindrical symmetry of the elastic scattering cross section. The constant energy cones therefore intercept planar slit plates placed before the detectors in conic sections. For ease of fabrication slits are typically configured as long narrow rectangles, and as a result energy resolution is adversely affected. It has been shown that the kinematic broadening caused by using rectangular slits is minimized when $L = 2 (W z \tan\Theta_{recoil})^{1/2}$ where W is the slit width, L is the slit length, z is the slit-target distance and Θ_{recoil} is the lab-frame recoil angle. The improved energy resolution which results when rectangular slits are replaced by appropriate curved slits is examined here. Formulas are given for the conic sections associated with the curved slits as a function of experimental geometry. When slit dimensions are small compared with the full extent of the conic section slit geometry can be accurately approximated as the arc of a circle with radius $R_c = z \tan\Theta_{recoil}$. Energy loss effects on the resolution are also accounted for in our treatment. The use of curved slits with $L = 4 (W z \tan\Theta_{recoil})^{1/2}$ is shown to improve kinematic broadening by ~50% as compared to optimized rectangular slits of the same area. 2 refs., 5 figs.

41052 (SFTI–88-4) **Analytic approximation of reaction cross sections and velocities of electron-atom collisions.** Maksimov, M.Z.; Chikovani, Z.E.; Shariya, O.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi (USSR). Fiziko-Tekhnicheskij Inst. 1988. 11p. (In Russian). Order Number DE89631806/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A fairly generalized and simple method is suggested for deriving analytical approximating correlations for reaction cross sections and rates in electron-atom collisions over a broad kinematic range. The method is based on the summing up perturbation theory series and asymptotic solutions joining. Specified data for the ionization cross section of a hydrogen atom are obtained. 10 refs.; 1 fig.; 1 tab.

41053 (UCID–21635) **Program IONE: A code designed to create an electron ionization data base in the ENDL format.** Perkins, S.T.; Cullen, D.E. Lawrence Livermore National Lab., CA (USA). 1 May 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013979/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The computer code IONE calculates electron induced ionization for: cross section; electron recoil spectra; spectrum averaged recoil energy, and spectrum averaged projectile secondary energy. The description of this code as well as examples are given in this paper. (LSP)

41054 (UCRL–100709-Rev.1) **Electron scattering assisted by an intense electromagnetic field-exact solution of a simplified model: Revision 1.** Sacks, R.A.; Szoeke, A. Lawrence Livermore National Lab., CA (USA). Jun 1989. 87p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8906183–1-Rev.1: Conference on super-intense laser-atom physics, Rochester, NY (USA), 28-30 Jun 1989). Order Number DE89015778/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Electron scattering by a layered (stepwise constant) potential is calculated in the presence of strong electromagnetic radiation. The numerical solution converges to high accuracy. We study threshold phenomena, resonant emission and absorption of many photons, multiphoton ionization, and the interaction of decaying "bound" states with each other and with the continuum. We demonstrate the close connection between electron scattering and multiphoton ionization. A theoretical treatment in terms of dressed states accounts well for most of our results. 48 refs., 14 figs.

41055 Use of VUV/XUV free-electron lasers in the study of defects in amorphous optical materials. Sanders, V.E. (Chemical and Laser Sciences Div., CLS-6, Los Alamos National Lab., Los Alamos, NM (US)); Newnam, B.E. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The authors propose to use an intense, coherent, light source in the VUV and XUV spectral regions, such as the proposed Los Alamos free-electron laser (FEL) user facility, to study radiation-induced defects in amorphous materials. The optical materials of interest are those associated with thin-film coatings, windows, and lenses used in most UV and visible lasers. The life, reliability, and performance of these lasers may be significantly affected by the UV environment of the laser. Examples include FELs themselves which generate harmonics of the fundamental lasing wavelength far into the VUV. Other examples include most, if not all, gas lasers where the optics, particularly thin-film coatings, are exposed to the gas plasma discharge.

41056 Novel magnetic materials research using free electron lasers. Bader, S.D. (Materials Science Div., Argonne National Lab., Argonne, IL (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Synchrotron-radiation sources have dramatically increased the research capabilities of materials scientists. The latter development permits spin-polarized photoelectron spectroscopy to become a convenient probe of magnetic materials. The form of spectroscopy warrants undulator radiation sources because electron spin detectors are inefficient by a factor of 10^{-4} compared to conventional photoelectron detection. Thus, it becomes very exciting to consider the future scientific possibilities offered in the ultimate stage in the source progression: the realization of soft x-ray free electron lasers (FEL). In the following, broad examples of magnetic materials research opportunities are considered. Order-of-magnitude estimates are then given of source flux and spin-polarized signal level for an undulator and an FEL source. The comparison illustrates the impact expected of FEL sources on magnetic materials research in the future.

41057 Angle dependent photoemission with high resolution. Kevan, S.D. (Dept. of Physics, Univ. of Oregon, Eugene, OR (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

In the past 15 years, angle-resolved photoelectron spectroscopy (ARPES) has progressed from a fairly low energy and momentum technique useful primarily in performing general surveys to one capable of detailed,high resolution studies of surface and bulk electronic structure. The primary reason for this progress is the increasing availability of sophisticated instrumentation. In particular, the various desirable characteristics of synchrotron radiation - high photon flux and brightness, tunable photon energy, and linear polarization - have allowed increasingly higher resolution and thus higher precision experiments to be performed. Future advances in producing vacuum ultraviolet and soft x-ray photons, including undulators and free electron lasers, will enhance even further the capabilities of the technique.

41058 New research opportunities in atomic photoionization with a high intensity narrow bandwidth photon source. Krause, M.O. (4832000). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988).

(CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Rarely ever has there been a period in atomic photoionization studies that the researcher has not felt a keen need for a greater photon flux, for a greater brilliance and for a higher energy resolution. This still holds true whether the authors concentrate on the very low photon energy region from 5 to 20 eV, the moderate energy region from 20 to 100 eV or the more energetic photons above 100 eV. However, at this juncture, photon sources are expected to become available in the near future which promise to deliver a very high flux of narrow-band photons with a small divergence into a very small area. This combination of parameters amounts to a high spectral brilliance, which is predicted to be 10^{18} photons/s (mm . mr)^2 0.001% BW at the sample target from 1 to a few hundred eV for a free-electron laser (FEL) photon source.

41059 UV-FEL applications in resonance ionization mass spectrometry. Nogar, N.S. (Chemical and Laser Sciences Div., MS G738, Los Alamos National Lab., Los Alamos, NM (US)); Fearey, B.L.; Miller, C.M. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Resonance Ionization Mass Spectrometry (RIMS) is a powerful tool for elemental and isotopic analysis. This multistep laser photoionization process, when coupled with conventional mass analysis, can provide exceptional performance in detectivity, dynamic range, and discrimination against interfering species. These properties can be used to great advantage both in the analysis of conventional analytical materials and in the interrogation of surface and interfacial phenomenae. Applications at Los Alamos include high dynamic range isotope ratio measurements, ground-water tracer measurements and optical damage studies. In this report, the authors discuss potential applications of a Free Electron Laser for RIMS analyses.

41060 Projected performance of RF-linac-driven free-electron lasers in the VUV and soft x-ray regions. Newnam, B.E. (Chemical and Laser Sciences Div., MS J564, Los Alamos National Lab., Los Alamos, NM (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

For the past three years, a multidisciplinary team of Los Alamos scientists, supported by the U.S. Department of Energy, has been developing the requisite technologies to extend free-electron laser (FEL) operation from infrared and visible wavelengths into the extreme-ultraviolet below 100 nm using rf-linear accelerator technology. The goal is to establish an XUV Free-Electron Laser User Facility, the next-generation light source that will make available to researchers optical power more than one-million times greater than provided by synchrotron light sources. Based primarily on a series of FEL oscillators driven by a single, rf-linac, the Los Alamos facility is designed to generate broadly tunable, picosecond-pulse, coherent radiation spanning the soft x-ray through the ultraviolet to the visible spectral ranges from 1 nm to 400 nm.

41061 X-ray absorption spectroscopy of elements of $Z \leq 10$ using a Free-Electron Laser source. Conradson, S.D. (Isotope and Nuclear Chemistry Div., Los Alamos National Lab., Los Alamos, NM (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Although X-ray Absorption Spectra (XAS) were first measured in the 1930's, it was not until synchrotron radiation became available in the 1970's that it became a feasible technique and the direct dependence of the XAS on the local structure of the absorbing element recognized. By a straightforward deconvolution, the Extended X-ray Absorption Fine Structure (EXAFS) region of the XAS provides the types and numbers of and distances to neighboring atoms within 3 - 4 A of the selected absorber. In addition, transitions to bound and quasi-bound final states produce features in the X-ray Absorption Near Edge Structure (XANES) region which can provide information on the electronic states and occupancies of the absorber and the three-dimensional arrangement of its near neighbors. Its ability to provide direct, structural information for any selected element in a sample in any physical state has made XAS a tool of increasing importance for determining local structures in metalloproteins, minerals, catalysts, and other non-crystalline systems.

41062 Highly-charged ion precision spectroscopy using free electron laser radiation. Church, D.A. (9501414); Kravis, S.D. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The characteristics of radiation potentially available from proposed rf-linac free electron lasers are considered here for precision spectroscopy of highly-charged ions. Such ions are usually produced in environments not conducive to precision measurements, such as high temperature plasmas for fast ion beams. However, highly-charged recoil ions with eV energies have been produced by impact of fast, stripped ions on atomic targets, and, using synchrotron radiation, multi-charged ions have been formed at thermal energies by K-shell photoionization followed by Auger emission and electron shake-off. Using each of these cold ion sources, multicharged ions have been stored under ultra-high vacuum conditions in Penning or radio-frequency ion traps, while maintaining the low energies at which the ions were generated.

41063 The radiobiology of ultrasoft x-rays. Freyer, J. (Life Sciences and Medium Energy Physics Div., Los Alamos National Lab., Los Alamos, NM (US)); Schillaci, M.; Carpenter, S.; Cornforth, M.; Sebring, R.; Schor, P.; Wilder, M.; Thompson, K.; Raju, M. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The authors have an ongoing project using ultrasoft x-rays as a tool to investigate the mechanisms of radiation-induced damage in biological systems. The data which are derived from these studies are used to test the assumptions of current models of the biological and chemical mechanisms of radiation damage. In principle, refinement of these models should aid in the extrapolation of biological data obtained at high radiation doses to the low-dose region. Basic mechanistic data may also improve their understanding of the therapeutic application of radiation in the treatment of cancer. Soft x-rays are particularly attractive for these studies because they deposit their energy over nanometer-scale dimensions, comparable to the size of critical target structures within mammalian cells.

41064 Ultraviolet photobiology. Sutherland, J. (Biology Dept., Brookhaven National Lab., Upton, NY (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The regions of the spectrum that are important here are the two windows where water is reasonably transparent. The major window in the absorption spectrum of water extends from below 200 nm in the ultraviolet (UV) to about 1,000 nm in the near infrared. The visible region of the spectrum (380 to 800 nm) is in the center of this window and all of the biological processes that are included in the dicipline of photobiology (vision, photosynthesis, photomovement, photomorphogenesis, bioluminescence, chronobiology, photosensitization and ultraviolet photobiology) involve wavelengths in some part of the 200 - 1000 water window. In evaluating potential roles for UV free electron lasers (FELs) the authors are interested in wavelengths less than about 400 nm. In this part of the spectrum most biological effects are detrimental to biological materials and fall under the subdiscipline referred to as UV photobiology.

41065 Spectroscopic and chemical applications of high-flux VUV and XUV free electron lasers. Stwalley, W.C. (Center for Laser Science and Engineering, Univ. of Iowa, Iowa City, IA (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318--: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

High-flux VUV and XUV Free Electron Lasers (FELs) would offer many new opportunities for extending the authors' knowledge of

atomic and molecular systems and their spectroscopy and dynamics. Obviously they offer the possibility of intense directed energy and thus laser-induced plasmas potentially of high temperature and density. The authors explore a quite different extension, namely the possibility of unique high energy (say > 10 eV) atomic and molecular metastable states where the finesse and surgical precision of the laser (e.g. operated in special (low entropy generation) ways, such as near threshold, with resonant enhancement, with near perfect polarization, counterpropagating to cancel doppler shifts, etc.) can be used.

41066 Application of XUV free-electron radiation for opacities of highly ionized atoms. Merts, A.L. (9512470). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The FEL has promise of affording a source that is essentially continuous in photon energy and is very intense and has some promise of covering two ranges of photon energy that are important for opacities (absorption coefficients). The important photon energy ranges fall into two regions: (I) photon energies greater than about 100 ev used for study of atoms and ions to be used primarily for high temperature plasmas made up of elements heavier than argon, and (II) photons below about 15 ev used to study molecules of use in planetary and stellar atmospheres. In addition, there is a need for a high intensity radiation source having photon energies in the 1 ev range. Here it is needed to investigate the electronic structure of metal clusters of atoms.

41067 The potential of free-electron lasers for x-ray holographic microscopy of biological specimens. Jacobsen, C. (5958000); Kirz, J.; DiGennaro, D.; Howells, M.; Rothman, S. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

X-ray microscopy is a rapidly developing field that could benefit greatly from $\lambda \leq 4.5$ nm Free Electron Lasers (FELs). Work in holographic microscopy make possible the recording of sub-optical resolution images of hydrated specimens in a matter of milliseconds. The authors discuss the exposure requirements of x-ray holographic microscopy, the opportunities and problems associated with reducing exposure times to the millisecond range and the potential that FELs hold for dramatically advancing work in this field.

41068 Use of a Free-Electron Laser in Knudsen Effusion Mass Spectroscopy Studies of actinide materials. Kleinschmidt, P.D. (Materials Science and Technology Div., Los Alamos National Lab., Mail Stop G-730, Los Alamos, NM (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

While the use of photoionization potentials to obtain bond dissociation energies of molecules is not unique, the application of this technique to the study of actinide systems, particularly the transplutonics is. Using ionization potentials to calculate bond dissociation energies and other thermodynamic quantities is desirable if limited quantities of material are available to generate the molecules of interest. One only needs to generate the molecule in a molecule in a molecular beam and measure its ionization and appearance potentials. Most ionization and fragment ion appearance potentials of interest fall in the 5 to 25 eV range (250 to 50 nm).

41069 Impact of VUV/soft x-ray Free Electron Lasers on the study of electron correlation in ions. Roy, P. (9512470); Bartlett, R.J. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The study of photoionization of isolated ions, because of its experimental difficulties has lagged that of neutrals even though ions are far more abundant in nature. Here the authors propose experiments to study the importance of electron correlation - the effect of the motion of one electron on that of all the others - in ions. Correlation effects are often examplified by multiple ionization and/or excitation in photoionization processes. The initial experiment described here consists of measuring the cross sections for single and multiple photoionization of several species. Because of the low density targets and the need for high resolution, the spectral brilliance of a Free Electron Laser (FEL) is required. In addition to providing an understanding of ionization dynamics, these measurements have application in Astrophysics, the study of plasmas, x-ray laser development and for testing calculational codes.

41070 Potential medical applications of UV Free-Electron Lasers. Esserman, L. (Dept. of Medicine (Oncology), Stanford Univ. Medical Center, Stanford, CA (US)); Conradson, S. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Reliable, high power CO_2, YAG, and Ar ion lasers are common medical instruments, having become the tool of choice in surgical applications as delicate as the repair of detached retinas and as coarse as the removal of polyps from the colon. For these lasers, the destruction of the selected tissue is a thermal process. The laser is simply a convenient means for delivering a sufficient amount of power to the required area to effect pyrolysis. Although obviously quite useful, it belies the impression of the laser as a superbly precise instrument since thermal decomposition is a rather dirty and crude process in terms of the reaction products and the inability to prevent damage to adjacent tissue. If, however, the excitation wavelength is lowered to the UV region below ca. 300 nm the decomposition mechanism changes. Instead of being limited to exciting vibrations and rotations in the exposed material, radiant energy is deposited into the covalent bonds of the biopolymer molecule, causing their direct fragmentation.

41071 Biophysical applications of the XUV Free Electron Laser. Johnston, R.G. (Biochemistry/Biophysics Group, Life Sciences Div., Los Alamos National Lab., Los Alamos, NM (US)); Edmondson, S.P.; Singham, S.B.; Salzman, G.C. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

There are a number of research techniques in use or under development in the Life Science Division at Los Alamos that would greatly benefit from the availability of a XUV Free Eectron laser. These techniques include: (1) ultrasensitive LD, CD, and absorption spectroscopy of molecules of biological interest, (2) elastic and inelastic measurements of the Mueller scattering matrix for biological macromolecules and particles, and (3) flow cytometry. Conventional spectrophotometry, LD, and CD techniques are important research tools at Los Alamos and elsewhere. Access to an intense, tunable VUV source would be beneficial. This is even more true for a new type of ultrasensitive spectrophotometry which the authors are developing at Los Alamos. This technique is a type of differential thermooptic spectroscopy, based on the two-frequency, Zeeman effect laser, for making ultrasensitive LD, CD, and absorption spectroscopy measurements.

41072 Molecular photoionization and photofragmentation studies using VUV radiation. Sander, R.K. (Univ. of California, Los Alamos National Lab., Los Alamos, NM (US)); Tiee, J.J. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

It has long been recognized that studies of molecular processes such as photoionization and photofragmentation can provide valuable spectroscopic and chemical dynamics information that can lead to a detailed mechanistic understanding of the energetics, structure, and reactivity of molecular species. With the availability of high power and tunable lasers in the uv and visible region, substantial progress has been made in recent years in understanding molecular dynamics through photoionization and photofragmentation studies. These works, however, are limited to only a few selected molecules and in some cases involve multiple photon excitation.

This is because most molecules undergo these molecular processes at excitation wavelengths shorter than 200 nm (i.e., in the VUV region) where few good laser sources are available. Synchrotron light sources have been applied to similar investigations in the VUV with limited success.

41073 **Photoionization and photofragmentation studies of Van Der Waals complexes using VUV radiation.** Walters, E.A. (4622000); Grover, J.R. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Van der Waals complexes are loosely bound clusters of atoms or moleculars which can be made conveniently by free jet expansions of pure or mixed vapors through a supersonic nozzle. Although these complexes are bound only by 0-0.2 eV, they have unique geometries that can be determined by techniques such as microwave spectroscopy. These species are of considerable interest not simply from the perspectives of molecular structure and thermodynamics, but more so because they are, for chemically reactive pairs, frozen collision complexes which can be isolated long enough to permit inspection of features such as stepwise solvent effects, energy transfer in oriented reactants, induction of chemical reactions, preparation of cationic reaction intermediates, and nonstatistical effects in unimolecular decomposition of ionic complexes. For some years now the authors have been using the technique for photoionization mass spectrometry to explore the neutral clusters.

6404 Fluid Physics

Refer also to citation(s) 40713

41074 (CONF-890856–1) **Effect of thermodynamic disequilibrium on critical liquid-vapor flow conditions.** Bilicki, Z.; Kestin, J. Brown Univ., Providence, RI (USA); Polska Akademia Nauk, Gdansk (Poland). Inst. Maszyn Przeplywowych. 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13687. From IUTAM symposium; Gottingen (Germany, F.R.); 28 Aug - 1 sep 1989. Order Number DE89008634/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this lecture we characterize the effect of absence of unconstrained thermodynamic equilibrium and onset of a metastable state on the adiabatic flow of a mixture of liquid and its vapor through a convergent-divergent nozzle. We study steady-state flows and emphasize the relations that are present when the flow is choked. In such cases, there exists a cross-section in which the flow is critical and in which the adiabatic wave of small amplitude is stationary. More precisely, the relaxation process which results from the lack of equilibrium causes the system to be dispersive. In such circumstances, the critical velocity is equal to the frozen speed of sound, a_f corresponding to $\omega \rightarrow \infty$. The relaxation process displaces the critical cross-section quite far downstream from the throat and places it in the divergent portion of the channel. We present the topological portrait of solutions in a suitably defined state-velocity space and discuss the potential appearance of normal and dispersed shock waves. In extreme cases, the singular point (usually a saddle) which enables the flow to become supercritical is displaced so far that it is located outside the exit. Then, the flow velocity is everywhere subcritical ($w < a_f$) even though it may exceed the equilibrium speed of sound ($w \gtrsim a_e$) beyond a certain cross-section, and in spite of the presence of a throat. 10 refs., 4 figs.

41075 (CRIE–T-87079) **Accuracy of the three-dimensional magnetic field calculation by the surface simulation method.** Kawamoto, Tadashi; Takuma, Kaoru. Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab. Sep 1988. 32p. (In Japanese). Order Number DE89772355/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 2-11-1, Iwato-kita, Komae, Tokyo, Japan.

An accurate three-dimensional magnetic field distribution arrangement is often required for the design of superconducting devices and nuclear fusion equipment. Surface magnetic charge method can be suitably applied to the analysis of three-dimensional fields. The charactersistics of the material must, however, be linear. The problem with the conventional surface magnetic charge method is illogical results obtained in the case of higher permeability substances. Study on the problems of the conventional surface charge method, solution to obtain logical calculated results, and calculation of three-dimensional arrangement calculating model for comparision were carried out to investigate the appropriate method of use and effectivity of the surface magnetic charge method. The measured and computed results were compared using a three-dimentional model, with the result of a very good agreement. The relative difference of the measured and computed magnetic flux density was 10% on the surface of the iron core and 20% on the shield. The memory capacity required for the computation of the surface charge method is about 7 million bytes when the unknown quantity is 840. 6 references, 15 figures, 4 tables.

41076 (DOE/ER/53194–2) **Nonlinear magnetohydrodynamics: Progress report, July 1, 1988–June 30, 1989.** Montgomery, D.C. Dartmouth Coll., Hanover, NH (USA). Dept. of Physics and Astronomy. Aug 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER53194. Order Number DE89015806/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our recent activity has been focussed on the following three subjects: turbulent relaxation processes in driven, dissipative MHD fluids in a dc magnetic field and the relaxed steady states that result; variational principles, particularly those of the minimum-dissipation-rate variety, as an analytical predictor of the properties of the relaxed states; and the inclusion of variable mass density and compression in the evolution of MHD turbulence. These areas represent for us sensible abstractions of the problems involving the principal uncertainties for tokamaks, reversed-field pinches, and other current-carrying confinement devices, as well as being of great importance for solar-terrestrial MHD processes. We now outline briefly each of these areas.

41077 (UCRL–21204) **A new flux-limited, two-dimensional, nonsymmetric tensor shock viscosity for DYNA2D: Progress report.** Benson, D.J. Lawrence Livermore National Lab., CA (USA); California Univ., San Diego, La Jolla, CA (USA). Dept. of Applied Mechanics and Engineering Sciences. 15 Aug 1988. 93p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015088/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

A new artificial viscosity that is being developed for DYNA2D is described in this progress report. It incorporates the one- dimensional, flux-limited viscosity developed by Randy Christensen into a two-dimensional setting. In addition, it tries to overcome some of the difficulties associated with traditional bulk viscosity formulations by using an nonsymmetric viscosity tensor. A different nonsymmetric approach (and a symmetrized version of it) is being used in SHALE by Len Margolin with great success. In a later section of this paper, the results of DYNA2D and SHALE for the "Saltzman problem" are compared. The general organization of this report is as follows: First it presents the one-dimensional, flux-limited viscosity developed by Christensen. An nonsymmetric tensor viscosity is then developed and the addition of flux-limiting to it is discussed. The issue of boundary conditions turns out to be crucial, and some issues associated with them are unresolved. The current boundary conditions and the issues associated with them are discussed. Example calculations are also given. The current work is summarized and future work is outlined in the first chapter. This brief progress report is the basis of a future journal paper. The work presented in here is unfinished, and some of the results and algorithms will undoubtedly be changed before the final paper. No attempt has been made to survey the results of others in this report, but a limited survey will be incorporated in the journal paper. 7 refs., 39 figs.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 40703, 40740, 40777, 41155, 41164, 41169, 41188

41078 (ANL-HEP-CP–89-07) **The CDF direct photon analysis.** Blair, R. CDF Collaboration. Argonne National Lab., IL (USA).

1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-8906153–1: 7. topical workshop on proton-antiproton collider physics, Batavia, IL (USA), 20-24 Jun 1989). Order Number DE89013644/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Using data from $\bar{p}p$ collisions observed in the CDF detector at $\sqrt{s}$ of 1.8TeV, a sample of events are selected which have calorimetry and tracking consistent with a single isolated photon produced in the central rapidity range ($-.9< \eta <.9$) with $P_T > 15$GeV. In the P_T range below 30GeV, the lateral shape of the shower measured at 6 radiation lengths is used to evaluate the fraction of events which are actually isolated neutral hadrons. The photon cross section versus P_T is compared with that expected from QCD plus lower energy collider measurements. 3 refs., 6 figs.

41079 (BNL–42856) **Investigation of color transparency by high transverse momentum pp elastic scattering inside nuclei.** Barton, D.S.; Bunce, G.; Carroll, A.S.; Gushue, S.; Makdisi, Y.I.; Heppelmann, S.; Courant, H.; Fang, G.Y.; Heller, K.J.; Marshak, M.L. Brookhaven National Lab., Upton, NY (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8903143–3: 24. Recontres de Moriond: new results in hadronic interactions, Les Arcs (France), 12-18 Mar 1989). Order Number DE89015109/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Following a suggestion of Mueller and Brodsky, we have measured (p, 2p) quasielastic scattering in nuclei at 90(degree) CM at momentum transfers of Q^2 = 4.8, 8.5 and 10.4 $(GeV/c)^2$. In a perturbative QCD model of large transverse momentum exclusive reactions, the hadrons which scatter are anomalously "small," and hence have a reduced absorption in nuclear matter over distances comparable to nuclear radii. At sufficiently high momentum, the absorption should vanish completely and lead to complete "color transparency." The absorption of the initial and final state protons as they pass through nuclear matter is determined from the ratio of the differential cross section for elastic scattering from protons in nuclei to that from free protons. The kinematic constraints of the experiment allow a clear extraction of the (p,2p) quasielastic signal, and a good measurement of the target proton momentum spectrum as probed by large momentum transfers. In contrast to a conventional Glauber picture of constant transparency, a striking energy dependence is observed in this experiment. 11 refs., 4 figs.

41080 (BONN-IR–89-05) **The production of strange particles in proton-antiproton interactions at c.m. energies from 200 to 900 GeV.** Pelzer, W. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Feb 1989. 121p. (In German). Order Number DE89795142/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

In this thesis the inclusive production of strange particles was studied in the framework of the UA5 streamer-chamber experiment at the SPS collider in inelastic panti p interactions at 200, 546, and 900 GeV c.m. energy. After the data taken of the UA5 experiment 1981 and 1982 at a c.m. energy of $\sqrt{s}$ = 546 GeV which yielded results both on general properties of inelastic interactions and on the production of strange particles by a new operation mode of the SPS collider 1985 also for the first time data at 200 and 900 GeV could be taken. The present study of the production of strange particles and its energy dependence in the range $5 \leq \sqrt{s} \leq 900$ GeV is based on the analysis of the decays of centrally produced K_s^0, $K^{\pm}$, Λ/anti Λ, and γ^-/anti γ^- observed in streamer chambers in about 6800 events at $\sqrt{s}$ = 900 GeV and 4100 events at $\sqrt{s}$ = 200 GeV. (orig.).

41081 **Detectors for glueballs, hybrids and exotic hadrons.** Gastaldi, U. (CERN, Geneva (Switzerland)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A brief summary is given on detectors and experimental approaches used or planned in spectroscopy of light mesons and in searches of exotics. 15 references.

41082 **Glueballs in 2^{++} $\phi\phi$ final states.** Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-76CH00016;AC02-83ER40107. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

This paper discusses the striking evidence obtained by BNL/CCNY for the $g_T(2010)$, $g_T'(2300)$ and $g_T''(2340)$ $I^GJ^{PC} = 0^+2^{++}$ resonances which comprise virtually all of the $\pi^-p \rightarrow \phi\phi n$. The complete breakdown of the expected OZI suppression, and the striking differences of these states from conventional states and background in other channels has so far only been successfully explained by assuming they are produced by 1-3 2^{++} glueballs. The comparison with J/ψ radiative decay results is made. A discussion of other glueball candidates in the light of a coupled channel analysis of the 2^{++} and 0^{++} channels is also made. The forthcoming search for an exotic J^{PC} glueball is discussed. 20 references, 10 figures, 2 tables.

41083 **Status of the $\theta/f_2(1720)$.** Hitlin, D.G. (California Institute of Technology, Pasadena (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The experimental situation with regard to the $\theta/f_2(1720)$ is reviewed and compared with those characteristics expected for a glueball. Production in radiative and direct J/ψ decay and central and low t hadronic reactions is discussed. Decay branching fraction ratios and spin-parity determinations are also reviewed. The characteristics of the $\theta/f_2(1720)$ appear to be very much in accord with those expected for a $J^P = 2^{++}$ glueball. 19 references, 10 figures, 7 tables.

41084 **E/ι in J/ψ decays.** Burnett, T.H. (Univ. of Washington, Seattle (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The author reviews the current experimental status of states seen in J/ψ decays in the mass range 1.2 to 1.6 GeV, in channels accessible to $J^{PC} = 0^{-+}$ or 1^{++}. While the emphasis is on understanding the f_1 (1420), or E, and η(1440), or ι, He also presents new results on the nearby f_1(1285). 20 references, 6 figures, 4 tables.

41085 **E/ι in hadroproduction.** Zieminska, D. (Indiana Univ., Bloomington (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-84ER40125. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A review is presented of new experimental results on the E/ι meson from hadronic experiments. The possibility that there is more than one pseudoscalar state under iota is discussed. 20 references, 6 figures, 1 table.

41086 **Latest results from GAMS.** Binon, F.G. (Fonds National de la Recherche Scientifique, Brussels (Belgium)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Some of the latest results of the GAMS Collaboration are reviewed. The $f_0(1590)$ has been observed in central collisions, adding support to its glueball nature. Evidence has been found for an exotic 1^{-+} meson M(1405) decaying into $\pi^0\eta$ in the exclusive reaction $\pi^-p \rightarrow$ M(1405)n at 100 GeV/c. New data are presented on the reaction $\pi^-p \rightarrow \omega\omega n$ at 38 GeV/c showing the presence of two tensor mesons. 22 references, 8 figures.

41087 **Spectroscopy of mesons containing strange quarks.** Aston, D. (Stanford Univ., CA (USA)); Awaji, N.; Bienz, T.; Bird, F.; D'Amore, J.; Dunwoodie, W.; Endorf, R.; Fujii, K.; Hayashii, H.; Iwata, S.; Johnson, W.B. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00515. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Recent results from a high statistics study with LASS of mesons which contain strange quarks are reviewed, and compared with the quark model. 13 references, 16 figures.

41088 **Resonance formation in photon-photon collisions.** Gidal, G. (Lawrence Berkeley Lab., CA (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Recent experimental progress on resonance formation in photon-photon collisions is reviewed with particular emphasis on the pseudoscalar and tensor nonets and on the $\gamma\gamma$ production on spin-one resonances. 37 references, 18 figures, 5 tables.

41089 **B^0-$\bar{B}^0$ mixing.** MacFarlane, D.B. (McGill Univ., Montreal, Quebec (Canada)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A review of evidence for B^0-$\bar{B}^0$ mixing from ARGUS and CLEO is presented. Both groups have made a careful study of like-sign dileptons events on the $\Upsilon(4S)$ and find significant excesses only attributable to the effects of mixing. These direct searches have been supplemented by cleaner partial-tag techniques, which, although not as statistically compelling, are less dependent on background estimates. 18 references, 2 figures, 2 tables.

41090 **Prospects for B physics spectroscopy in Fermilab fixed target experiments.** Cox, B. (Univ. of Virginia, Charlottesville (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A variety of experimental proposals have been made to attempt to study B physics in Fermilab fixed target experiments. While these experiments must overcome formidable experimental hurdles, they present intriguing opportunities to accumulate much larger samples of reconstructed B decays than have hitherto been available. A brief evaluation of the prospects for the approved Fermilab TEV II experiments which plan to attempt this sort of experiment is given in this paper. 23 references, 10 figures, 1 table.

41091 **Study of the E(1420) in $\bar{p}p$ annihilation at rest in H_2 gas.** Ahmad, S.; Amsler, C.; Auld, E.G.; Axen, D.A.; Bailey, D.; Barlag, S.; Beer, G.A.; Bizot, J.C.; Botlo, M.; Dahme, W.; Delcourt, B. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The authors have observed the E meson produced in $\bar{p}p$ annihilation at rest in a H_2 gas target at NTP. The mass and width are M = 1413 $\pm$ 8 MeV and Γ = 62 $\pm$ 16 MeV. There is strong evidence (3σ) for the production of the f_1 (1285) in the same final state. The partial-wave analysis of the E decay Dalitz plot gives no preference for the spin-parity assignments 0^{-+} or 1^{++}. The absolute branching ratio for (60 $\pm$ 10%) P wave annihilation is (3 $\pm$ 0.9) x 10^{-4}, compared to (7.1 $\pm$ 0.7) x 10^{-4} in liquid H_2, suggesting that $\pi\pi$E production is strongly suppressed in the P-wave. This result supports the 0^- spin-parity assignment for the E meson. 12 references, 5 figures.

41092 **Light gluinos.** Farrar, G.R. (Rutgers, The State Univ. of New Jersey, Piscataway (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Theoretical and experimental evidence regarding the possibility of a light gluino, having mass less than about 1 GeV, is reviewed. It is found that this gluino mass range, corresponding to gluino-containing hadron masses less than 1.5-2.5 GeV, is not ruled out if the gluino is the lightest supersymmetric partner and/or the squark masses are greater than several hundred GeV. If there is a light gluino, one of the clearest signals is the existance of extra flavor-singlet 0^{-+} and 1^{++} states in the meson spectrum, mixtures of gluino-gluino bound states with the standard $q\bar{q}$ and gluon bound states. 10 references, 2 figures.

41093 **Glueballs: advances, problems, mysteries.** Meshkov, S. (National Institute of Standards and Technology, Gaithersburg, MD (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Identifying glueballs is intimately intertwined with the study of meson spectroscopy. Recent experimental results agree remarkably well with QCD inspired predictions for the masses of the O^{-+}, $1^{\pm}$, 1^{++} mesons. For the O^{-+} and 1^{++} systems, these agreements lead to the possibility of identifying additional states as candidates for exotica. Major mysteries are: what is the $\theta(1720)$, and, why are the 2^{++} g_T states not seen in $J/\psi \rightarrow \gamma\phi\phi$, in view of the fact that the OZI-violating mechanism should be a good way to produce glueballs? 34 references, 3 tables.

41094 **Observation of K_sK_s-states in π^-p- and K^-p-interactions at 40 GeV energy.** Bolonkin, B.V. (Institute of Theoretical and Experimental Physics, Moscow (USSR)); Bloshenko, S.K.; Vladimirsky, V.V.; Grigor'ev, V.K.; Grishin, A.P.; Erofeev, I.A.; Erofeeva, O.N.; Katinov, Yu.V.; Korolkov, I.Yu.; Lisin, V.I.; Luzin, V.N. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The K_sK_s-states were studied at incident momentum 40 GeV/c making use of the 6-m magnetic spark spectrometer MSS ITEP with electromagnetical readout. In the reaction $\pi^- \rightarrow K_sK_sn$ besides the well-known resonances the $\theta(1700)$, $\xi(2230)$ states in the D_0 wave and the $\epsilon'(1440)$, $S^*(1720)$ states in the S wave were found. There is also some evidence for existence of X(3085) resonance with $J^{pc} = 4^{++}$. In the reaction $K^{minus}p \rightarrow K_sK_sY^*$ the f'(1525) meson with very small background was observed. This meson is produced mainly by natural exchange. Some conclusions about the nature of the $\theta(1700)$ and X(3085) resonances were drawn. 3 references, 6 figures.

41095 **Results from MARK III on the J/ψ decays.** Mallik, U. (Univ. of Iowa, Iowa City (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The MARK III detector at the SPEAR e^+e^- storage ring at SLAC accumulated a data sample of 5.8 x 10^6 J/ψ produced in 1982, 83 and 85. Recent results in radiative decays, including different decay modes of the η_c and the search for scalars, are presented. The systematic study of the hadronic decays of the J/ψ into a vector-tensor meson pair is discussed, and a detailed analysis of the decay mode $J/\psi \rightarrow \omega f_2(1270)$ is described. 12 references, 12 figures, 1 table.

41096 **Search for glueballs in the central region in the reaction pp $\rightarrow$ pf(X^0)ps at 300 GeV/c using the CERN (Omega) spectrometer.** Armstrong, T.A. (CERN, Geneva (Switzerland)); Benayoun, M.; Beusch, W.; Bloodworth, I.J.; Caponero, M.; Carney, J.N.; Childs, R.; French, B.R.; Ghidini, B.; Goldschmidt-Clermont, Y.; Jacholkowski, A. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The aim of this experiment is to search for gluonic mesons in the reaction pp $\rightarrow$ pf(X^0)ps at 300 GeV/c incident momentum, where the X^0 system is a centrally produced meson. Preliminary results are presented on the two-body ($\pi^+\pi^-$, K^+K^-, $K^0_SK^0S$, $p\bar{p}$), three body ($K^0_SK^{\pm}\pi^{\mp}$) and four-body ($2\pi^+2\pi^-$) decays of the X^0 system. 19 references, 14 figures, 1 table.

41097 **Strangeonium spectrum seen in LASS; implications for glueball spectroscopy.** Aston, D. (Stanford Univ., CA (USA)); Awaji, N.; Bienz, T.; Bird, F.; D'Amore, J.; Dunwoodie, W.; Endorf, R.; Fujii, K.; Hayashii, H.; Iwata, S.; Johnson, W.B. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American

Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00515. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The status of strangeonium spectroscopy is re-assessed following their recent high statistics study of K^- induced hypercharge exchange reactions. The implications of their results for the status of glueball, or otherwise exotic, candidates observed in the same decay modes but produced by different mechanisms are also discussed. 11 references, 8 figures.

41098 Series of experiments at KEK for light quark meson spectroscopy, E64/121/135. Inagaki, T. (National Lab. for High energy Physics, Ibaraki (Japan)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A series of experiments of π^-p charge exchange the reaction at KEK 12 GeV proton synchrotron have been done. Here the recent analysis in the reactions $\pi^-p \rightarrow K^{\pm}K_s\pi^{minus_plus}n$, $\pi^-p \rightarrow \pi^+\pi^-\pi^0n$ and $\pi^-p \rightarrow \pi^+\pi^-\eta n$ are reported. 11 figures.

41099 Mass dependent fits of the partial wave analysis of the $K^+\bar{K}^0\pi^-$ system. Blessing, S. (Indiana Univ., Bloomington (USA)); Crittenden, R.; Dzierba, A.; Marshall, T.; Teige, S.; Zieminska, D.; Birman, A.; Chung, S.U.; Peaslee, D.; Fernow, R.; Kirk, H. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The authors have performed a partial wave analysis of the $K^+K^0_S\pi^-$ system produced in the reaction $\pi^-p \rightarrow K^+\bar{K}^0\pi^-$ at 8 GeV/c. They present the mass dependent fits to the PWA results for the waves J^{PG} (isobar) = 0^{-+} (a_0), 0^{-+} (K^*), 1^{++}(a_0) and 1^{++} (K^*). 4 references, 5 figures, 1 table.

41100 Analysis of the reaction $\pi^-p \rightarrow \pi^0\eta$ n at 100 GeV GAMS-NA12 collaboration. Boutemeur, M. (Lab d'Annecy-le-Vieux (France)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A partial wave analysis of the $\pi^0\eta$ angular distributions has been performed using three different methods. It clearly indicates the existence of a resonance with exotic quantum numbers. This is the first observation of a meson that can in no way be a $q\bar{q}$ state. A new peak is also observed in the S wave at $M_{\pi^0\eta} \simeq 1300$ MeV, it could be the regular a_0 member of the $^3P_0$ scalar nonet. 14 references, 5 figures, 1 table.

41101 Primakoff production of hybrid mesons. Zielinski, M. (Univ. of Rochester, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The viability of Primakoff technique in searching for hybrid states, and exotic $J^{PC} = 1^{-+}$ isovector meson $\tilde{\rho}$ in particular, is discussed. Results of searches for Primakoff production of an $\tilde{\rho}$ in $\rho\pi$ and $\eta\pi$ final states produced in high energy interactions of pions with large-Z nuclei are reviewed, and the limits for the radiative coupling $\Gamma(\tilde{\rho}^+ \rightarrow \pi^+\gamma)$ are presented. Based on available experimental information, electromagnetic production rate estimates are given for the favored $\tilde{\rho} \rightarrow \pi f_1(1285)$ channel. It is argued that a dedicated Primakoff production experiment can be sensitive to values of $\Gamma(\tilde{\rho}^+ \rightarrow \pi^+\gamma) \sim$ keV, which makes such measurement a very interesting option for doing spectroscopy of gluonic (and conventional) meson states in the 1.5 ~ 3 GeV mass range. 18 references, 2 figures.

41102 Preliminary results from BNL E766 on pp -> pp K_S^0 Kπ. Hartouni, E.P. (Univ. of Massachusetts, Amherst (USA)); Jensen, D.; Klima, B.; Kreisler, M.; Rabin, M.; Uribe, J.; Church, M.; Knapp, B.; Gottschalk, E.; Sippach, W.; Stern, B. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

This brief talk will present the very preliminary results of an ongoing data analysis of the data from BNL E766. These results should be thought of as a first look at the data rather than a full blown analysis. It is the nature of workshops that new and evolving results can be presented and discussed, and the future course of the analysis can be discussed among a few interested and informed groups. BNL E766 was an experiment to study heavy particle spectroscopy in np (15 - 24 GeV) and pp interactions (28 GeV). The apparatus consisted of a large aperture magnetic spectrometer and a highly segmented particle identification system. The detector system accurately measured high multiplicity events at a few 10^6 interactions per second. The flexible trigger and data acquisition system allowed a high multiplicity subset of the interactions to be written onto tape at several 10_3 events per second. During the 1985 SEB run at the AGS the experiment recorded 3 x 10^8 np events in a two week period. In 1986, the acquisition system was reconfigured and the beam line modified to provide an intense proton beam. A beam spectrometer system was added to the apparatus to provide an accurate measure of the beam particle momentum. The run resulted in the collections of 3 x 10^8 pp events in approximately six beam days. 3 figures.

41103 Study of meson spectroscopy on Lepton apparatus. Landsberg, L.G. (Institute for High Energy Physics, Moscow (USSR)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The paper is devoted to the experiments on Lepton set up. In these experiments new vector meson C(1480) $\rightarrow \phi\pi^0$ - a candidate for an exotic state - has been observed and studied, the rare radiative decay D(1285) $\rightarrow \gamma$ has been found and new data on the OZI rule in hadron reactions and decays have been obtained. 19 references, 4 figures.

41104 U meson results from the CERN hyperon beam. Smith, V.J. (Univ. of Bristol (England)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The evidence for narrow resonances at masses near 3100 MeV/c^2, in 4 charge states, and decaying to $\Lambda\ \bar{p}$ + π's is reviewed. Although no conventional explanation for these states exists, they have some properties which could be consistent with Mock Baryonium: an (sq-$\bar{q}$q) exotic hadron. 8 references, 2 figures, 1 table.

41105 Preliminary results of $\bar{p}p$ at 8 GeV/c. Boehnlein, A. (Florida State Univ., Tallahassee (USA)); Boehnlein, D.; Goldman, J.H.; Hagopian, V.; Birman, A.; Chung, S.U.; Peaslee, D.; Fernow, R.; Kirk, H.; Protopopescu, S.D.; Weygand, D. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The authors are studying the reactions $\bar{p}p \rightarrow K^+\bar{K}^0\pi^-$ X and $\bar{p}p \rightarrow \bar{\Lambda}p\pi$ X. They present mass spectra for the systems produced in these reactions. The data represent one-half of the total data collected. 3 references, 4 figures.

41106 Peaks in the valley: searching for resonances in large angle exclusive scattering. Carroll, A.S. (Brookhaven National Lab., Upton, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The problem posed for this talk is how to find high mass, relatively broad width, low spin resonances in the midst of very large diffractive backgrounds in hadronic interactions. One possible answer is to study large angle exclusive scattering where the forward diffraction has gone away and the background is small. Moreover, this background may be at least partially understood in the context of perturbative Quantum Chromodynamics (pQCD). In this talk the results from AGS Experiment 834 are described. 13 references, 6 figures.

41107 Production of $\bar{\Lambda}\Lambda$ and $\bar{K}^0K^0$ in antiproton induced processes. Barnes, P.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)); Birien, P.; Bonner, B.E.; Breunlich, W.H.; Diebold, G.; Dutty, W.; Eisenstein, R.A.; Ericsson, G.; Eyrich, W.; von Frankenberg, R.; Franklin, G. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Results from the experiment PS185 investigating the production of antilambda $\bar{\Lambda}$ lambda Λ and K^0 $\bar{K}^0$ out of the antiproton ($\bar{p}$) proton (p) annihilation are reported. In particular, the threshold measurements of the reaction $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$ is discussed. From the shapes of the excitation function and of the angular distributions higher angular momentum contributions are concluded even at energies close to threshold. An interconnection of the $\bar{\Lambda}\Lambda$ and the $\bar{K}^0$ K^0 channels to the $\xi(2230)$ resonance is searched for. 5 references, 5 figures.

41108 Two-photon formation of spin-one resonances and the nature of the E(1420). Caldwell, D.O. (Univ. of California, Santa Barbara (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A powerful new tool in meson spectroscopy has become available with the recent observation of two spin-one mesons produced by the interaction of one nearly real and one highly virtual photon. The first of these mesons, detected initially by the TPC/2γ collaboration and confirmed by the Mark II, JADE, and CELLO collaborations almost surely not a $q\bar{q}$ state. It has a mass, width, and K^* (892)K decay like the E(1420) observed in hadronic reactions and reported variously as 0^- and 1^+. Its observation with $\gamma\gamma^*$ (single-tagged) and not with $\gamma\gamma$ (untagged) shows it to be spin one. To calibrate this observation, a known spin-one state, the $J^{PC} = 1^{++}$ $f_1(1285)$, or D, was observed in the state $\eta\pi^+\pi^-$ by the same experimental groups. The two-photon widths of these two mesons are not consistent with their both being in the ground-state axial vector nonet, and there are many reasons why the E is not that mainly $s\bar{s}$ state. It is likely to be a four-quark state, probably as a K*K molecule. 19 references, 3 figures, 1 table.

41109 $\rho^0\rho^0$ production in photon-photon interactions. Kernel, G. (Univerza v Ljubljani (Yugoslavia)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Existing experimental data on $\gamma\gamma \rightarrow \rho^0\rho^0$ are reviewed. It is shown that the published results for spin-parity composition of the cross section are not consistent with each other. A Monte-Carlo study is performed to trace the origin of the disagreement. It turns out that the results of the analysis are not sensitive enough to the assumptions about the partial amplitudes and phases in order to justify the differences. It is concluded that they are most likely due to uncertainties in acceptance calculations and low statistics. A high-statistics sample of ARGUS data taken at a cms energy of about 10 GeV is analyzed and it is found that most of the cross section can be attributed to a $J^P = 2^+$, helicity 2 partial wave. This together with recent ARGUS data on $\gamma\gamma \rightarrow \rho^+\rho^-$ suggests a $qq\bar{q}\bar{q}$ interpretation of the threshold enhancement in the $\gamma\gamma \rightarrow \rho^0\rho^0$ cross section. 4 references, 3 figures.

41110 Vector meson pair production in two-photon collisions at ARGUS. Patel, P.M. (McGill Univ., Montreal, Quebec (Canada)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

New ARGUS results on exclusive final states produced in two-photon interactions are presented. Measurements of the vector meson pairs $\rho^+\rho^-$, $\omega\rho^0$, $\omega\omega$, K^{*+} K^{*-} and K^{*0} $\bar{K}^{*0}$, as well as a search for $\phi\rho^0$, $\phi\omega$ and $\phi\phi$, are described. The results are compared with theoretical models. It is concluded that none of the models tells the full story when one considers the ARGUS data on all the possible vector meson pairs constructed from the 1^- vector nonet. 17 references, 5 figures, 1 table.

41111 Observed and unobserved states - crystal ball results on two-photon physics. Bienlein, J.K. (DESY, Hamburg (West Germany)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The Crystal Ball detector at the e^+e^--storage ring DORIS-II has measured the $\gamma\gamma$-excitation of resonances decaying into final states with photons only. The results are presented by the partial widths $\Lambda_{\gamma\gamma}$ as well as by their helicity form factors. Upper limits on candidates for radially excited mesons as well as gluonia are reported and can easily be compared with values of observed resonances using the helicity form factors. Octet-singlet mixing angles are derived. 9 references, 3 figures, 3 tables.

41112 Vector-vector production in photon-photon interactions. Ronan, M.T. (Lawrence Berkeley Lab., CA (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00098. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Measurements of exclusive untagged $\rho^0\rho^0$, $\rho\phi$, $K^*\bar{K}^*$, and $\rho\omega$ production and tagged $\rho^0\rho^0$ production in photon-photon interactions by the TPC/Two-Gamma experiment are reviewed. Comparisons to the results of other experiments and to models of vector-vector production are made. Fits to the data following a four quark model prescription for vector meson pair production are also presented. 10 references, 9 figures, 1 table.

41113 1988 CELLO, JADE and PLUTO contributions to exotic meson spectroscopy. Feindt, M. (Universitaet Hamburg (West Germany)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

This article reviews selected recent results on resonance formation in $\gamma\gamma$ reactions obtained with the CELLO, JADE and PLUTO spectrometers at the e^+e^- storage ring PETRA. New stringent limits on the $\gamma\gamma$ coupling of glueball candidates as well as new results on tensor and scalar mesons are presented. The recent observation of $\pi_2(1680)$ formation is confirmed by the CELLO group. Finally the two spin 1 states observed in $\gamma\gamma^*$ interactions, in particular the parity of the $X_1(1420)$ and the model dependence of present analyses are discussed. 37 references, 2 figures, 4 tables.

41114 Search for four-quark states in $\gamma\gamma$-collisions. Achasov, N.N. (Institute of Mathematics, Novosibirsk (USSR)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

In the beginning of the eighties a program was suggested to search for the four-quark states in the $\gamma\gamma$-collisions. The investigation was provoked by the discovery of the giant enhancement in the cross-section of $\gamma\gamma \rightarrow \rho^0\rho^0$ near its threshold which had not (and have not up to now) a natural normal explanation. Using the vector meson dominance model and the MIT bag model four-quark states, it was showed that the enhancement in $\gamma\gamma \rightarrow \rho^0\rho^0$ can be attributed to the production of tensor q^2q^{-2} states, but there should be no similar enhancement in $\gamma\gamma \rightarrow \rho^+\rho^-$. The reason for these conclusions is that the reaction $\gamma\gamma \rightarrow \rho\rho$ gives rise to several q^2q^{-2} tensor states, one of which, the exotic with an isospin I=2, interferes with the isoscalar resonances constructively in $\gamma\gamma \rightarrow \rho^0\rho^0$ and destructively in $\gamma\gamma \rightarrow \rho^+\rho^-$. Experiments confirmed this prediction. 17 references.

41115 Prospects for beauty physics at hadron colliders or what to do when the glue doesn't stick. McDonald, K.T. (Princeton Univ., NJ (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The cross section for $gg \rightarrow B\bar{B}$ is relatively high at collider energies, so that a one year run at RHIC or TEV I might yield $> 10^{10}$ $B\text{-}\bar{B}$ pairs, and $> 10^{12}$ pairs at the SSC. The challenge to the experimenter is to trigger on and reconstruct a significant fraction of

this sample. Detectors are being proposed which make extensive use of silicon vertexing, VLSI readout, and massive online numerical processing with the goal of maintaining a 1% efficiency for few-body decays to all-charged final states. If achieved at the SSC for $L = 10^{32}$ cm^{-2} sec^{-1}, this would be equivalent to an e^+e^- B factory operating at $L = 10_{36}$ cm^{-2} sec^{-1} and 100% reconstruction efficiency. Even at RHIC or TEV I with 10^8 reconstructible B's, the strongest signals for CP violation in the B-$\bar{B}$ system would be accessible. 11 references, 5 figures.

41116 Search for new heavy flavors with AMY at tristan. Son, D. (Kyungpook National Univ., Taegu (Korea)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The hadronic cross sections at E_{cm} = 50, 52, 55, and 56 GeV have been measured. Event shape variables have been examined for evidence of new heavy flavor production. Lower mass limits of 26.9 GeV/c^2 for a t-quark (e_q = +2/3e) and 23.8 GeV/c^2 for a fourth generation b'-quark (e_q = −1/3e) with 95% CL have been established. By searching for low thrust hadronic events with leptons, a lower limit of 25.5 GeV/c^2 on the mass of the lightest b' flavored hadron with 95% CL has been set. 4 references, 3 figures, 2 tables.

41117 Charm physics. Purohit, M.V. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The status of charm physics with emphasis on recent high statistics results from fixed target experiments is presented. The topics covered include charm production, $D^0\bar{D}^0$ mixing, charm baryons and excited states such as the D^{**}. Also reviewed are charm decays: hadronic, leptonic as well as semileptonic. Finally, a brief look is taken at charm lifetimes before concluding with a look to the future. 28 references, 2 figures, 1 table.

41118 Measurement of the direct photon spectrum from the Υ(1S). Schuette, J. (Universitaet Erlangen/Nuernberg (West Germany)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Using the Crystal Ball detector at the e^+e^- - storage ring DORIS II the direct photon spectrum from the Υ(1S). Interpreting these photons to come from the decay $\Upsilon \rightarrow \gamma gg$ the author determines the ratio $r = \Lambda(\Upsilon \rightarrow \gamma gg)/\Lambda(\Upsilon \rightarrow ggg) = (2.7 \pm 0.2 \pm 0.4)\%$. This ratio r is used to deduce the strong coupling constant in the $\overline{MS}$ scheme at $Q^2 = (1.5\ GeV)^2$ to be $a_5 = 0.25 \pm 0.02 \pm 0.04$. While the prediction of the shape of the spectrum by R.D. Field fits their data well, the prediction of the lowest order QCD can clearly be ruled out. 10 references, 2 figures.

41119 Latest results on charmed baryons Ξ_c^+ and Ω_c^0. Smith, V.J. (Univ. of Bristol (England)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The observation of charmed-strange baryons Ξ_c^+ (nee A^+) and Ω_c^0 (nee T^0) at the Cern-SPS and Fermilab is discussed. Some questions about the production and decay of these particles are mentioned, and currently proposed experiments to address these questions are briefly presented. 5 references, 2 figures.

41120 B physics with CLEO II. Shipsey, I.P.J. (Syracuse Univ., NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A status report of the CLEO II upgrade is given. Data collection is expected to start in mid 1989. The improved ability to reconstruct B mesons with the new detector is briefly discussed. 13 references, 3 figures, 3 tables.

41121 Color transparency and J/ψ formation in antiproton-nucleus collisions. Heppelmann, S. (Pennsylvania State Univ., University Park (USA)); Smith, G.A. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The possible observation of color transparency effects in J/ψ formation with an antiproton beam incident on a nuclear gas jet in the Fermilab E-760 detector is considered. 7 references, 1 figure.

41122 Properties of charm particles produced in hadron interactions (360 GeV/c π^-p, 400 GeV/c pp). Aguilar-Benitz, M. (CIEMAT-JEN, Madrid (Spain)); Josa, M.I. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A summary of the properties of charm particles produced in 360 GeV/c π^-p and 400 GeV/c pp interactions is reported. The experiment was performed using the high resolution hydrogen bubble chamber LEBC in association with the European Hybrid Spectrometer at the CERN SPS. A brief description of the experimental set up and a resume of the charm decay samples obtained is given. Results are presented on some of the intrinsic properties of charm particles measured in this experiment. The hadroproduction properties of charm states are presented and compared with predictions emerging from QCD inspired phenomenology. 9 references, 6 figures, 1 table.

41123 Study of neutral mesons decaying into multi-photon final states. Dzierba, A.R. (Indiana Univ., Bloomington (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

A number of meson states, the M(1405), G(1590), θ(1700), which are candidates for hybrid or glueball states have been observed in experiments decaying into multi-γ states. It is important to confirm the existence of these states (especially the M and G) and measure their branching ratios and hadronic production characteristics in an independent experiment. The author proposes to use a lead glass photon detector at BNL to look at all neutral final states in the reaction $\pi^-p \rightarrow X^0n$ at 22 GeV where X^0 is a neutral meson system which decays into several γ's. 9 references.

41124 Elementary π^0, η capability at the MPS. Peaslee, D.C. (Univ. of Maryland, College Park (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

It is proposed to place a simple lead glass wall at the downstream end of the MPS, covering one half the exit aperture. Monte Carlo studies indicate that 4" to 6" blocks will give adequate 2γ resolution for reaction at an incident momentum of 8 GeV/c. Investigation of two newly reported isovector vector mesons will be enabled: $C(1480) \rightarrow \pi\phi$ and $M(1405) \rightarrow \pi\eta$. 4 references, 1 figure.

41125 Search for a J^{PC} exotic hybrid meson. Chung, S.U. (Brookhaven National Lab., Upton, NY (USA)); Fernow, R.; Kirk, H.; Protopopescu, S.D.; Willutzki, H.; Crittenden, R.; Dzierba, A.; Marshall, T.; Zieminska, D.; Bonner, B.E.; Roberts, J.B. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

This paper describes an experiment that will search for J^{PC} hybrid mesons at the Brookhaven MPS-II facility. Such explicitly exotic states are allowed in QCD, and are predicted to be in an accessible mass region by several models. The experiment will investigate the production of exotics in the reaction $\pi^- p \rightarrow \pi^- f_1 p$. Expected rates and experimental sensitivity to possible hybrid states are discussed. 3 references, 3 figures.

41126 Jetset experiment at LEAR. Eisenstein, R.A. (Univ. of Illinois, Champaign (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The Jetset experiment (PS 202) at LEAR will search for gluonic hadrons and other exotics in the interaction of in-flight antiprotons with protons at rest. The mass range to be covered extends from 1.96 to 2.43 GeV. The experiment uses a molecular hydrogen cluster jet target which is inserted in the LEAR ring and is surrounded by a general-purpose detector of advanced design. In Phase I the detector will be constructed to provide selection at the trigger level of four kaon events, allowing a search for resonances in the OZI-forbidden, gluon-rich reaction $\bar{p}p \rightarrow \phi\phi \rightarrow 4K$. The combination of LEAR with their detector is unique in that it allow scanning over a large momentum range with excellent momentum resolution, implying correspondingly excellent mass resolution. The physics interest in this process is outlined briefly, and the status of the detector construction is described in some detail. A brief discussion of possible upgrade paths for the detector is given at the end. 10 references, 2 figures.

41127 Use of TPC's as target region detectors in the MPS. Foley, K.J. (Brookhaven National Lab., Upton, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-76CH00016. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

An important criterion for detectors near the target in the MPS is the need to minimize the amount of material in the path of particles entering the main drift chamber system. This is difficult to achieve with standard wire chambers because of the need to support tension in the anodes and field wires. The time projection chamber can have a significant advantage in this case since the active volume is the drift region, and the parts of the chamber with critical wires can be located very much out of the way, near the magnet pole. Other than gas containment, one has just to arrange to support a field cage to provide a uniform electric field. Since the pioneering work of the PEP4 TPC many have been built, each tailored to a specific experiment. 2 figures.

41128 Fermilab E-760 charmonium detector. Ray, R. (Northwestern Univ., Evanston, IL (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-76ER02289. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The masses and widths of many of the charmonium states are still not sufficiently well known to determine the relative contributions of the various terms to the $c\bar{c}$ potential (spin-spin, tensor etc.). The charmonium region also offers a number of other interesting physics possibilities along the lines of exotics, glueballs, etc. The Fermilab E-760 detector has been designed to address many of these issues. A brief description of the detector and the anticipated physics program is given. 7 references, 5 figures, 1 table.

41129 Crystal barrel at LEAR. Amsler, C. (Universitaet Zuerich (Switzerland)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The Crystal Barrel is a 4π magnetic detector with good efficiency and good angular and momentum resolutions for the detection of multiparticle final states that include several photons. It is especially suited for the study of low energy $\bar{p}p$ and e^+e^- annihilations. The detector is presently being constructed at LEAR for meson spectroscopy in $\bar{p}p$ annihilation at rest and up to 2 GeV/c. It will become fully operational in 1989. 16 references, 3 figures, 1 table.

41130 Review of RHIC as a B factory. Morse, W.M. (Brookhaven National Lab., Upton, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-76CH00016. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The author discusses a dedicated B physics experiment which was considered at the 1988 RHIC Summer Workshop. The machine may operate in a p-p mode with a luminosity in excess of 10^{32} cm^{-2} sec^{-1} at 250 x 250 GeV. The most ambitious physics objective of such an experiment would be the study of CP nonconservation. Particular emphasis at the workshop was given to the self tagging mode $B \rightarrow K^+\pi^-$. Experimental techniques developed during this experiment would be extremely useful for more ambitious projects anticipated at the SSC. 3 figures.

41131 Future opportunities for hadron spectroscopy at the MPS. Longacre, R.S. (Brookhaven National Lab., Upton, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-76CH00016. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The author gives a summary of the status of lattice gauge calculations of glueball masses plus glueball and hybrid masses from the bag model and flux tube model. Then he goes on to discuss experiments at MPS for hadron spectroscopy. 15 references, 2 figures.

41132 E179 experiment at KEK search for 1^{-+} resonances in the $\eta\pi^-$ channel. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.). American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

This paper presents the plan of E179 experiment at KEK. This experiment is intended to search for 1^{-+} resonances in the $\eta\pi^-$ channel by the charged and neutral spectrometer at KEK. The reaction is $\pi^-p \rightarrow \eta\pi^-$ p, $\eta \rightarrow \gamma\gamma$, at 6 Gev/c. A resonance decaying into $\eta\pi$ with P-wave should have a quantum number of $J^{pc} = 1^{-+}$. $q\bar{q}$-bound states can not at all have such a quantum number. In another words, the 1^{-+} resonance is $qq\bar{q}$ exotic state; in this case, that is not a glueball but a hybrid or a four-quark state. Thus $\eta\pi$ is a good channel to search for exotic resonances clearly. Very recently, 1^{-+} resonance at 1.4 GeV was reported by the GAMS collaboration. It was observed in the $\eta\pi^0$ channel in $\pi^-p \rightarrow \eta\pi^0$ n. The purpose of the experiment is to observe such resonances in another reaction, that is, non-charge-exchange reaction of π^- p, and yet, in another isospin state of $\eta\pi^-$. 3 references, 3 figures, 1 table.

41133 Summary of heavy flavor physics. Goldberg, M. (Syracuse Univ., NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The presentations concerning heavy flavor physics at the 1988 BNL Workshop are summarized. Heavy flavor physics received special attention at this year's workshop. New results on $B\bar{B}$ mixing, charmless decays of B's and prospects for future CP violation experiments were of particular interest. Studies of charm via hadronic production have become competitive with results from e^+e^- colliders. 5 references.

41134 Summary of the hybrids and exotics sessions. Godfrey, S. (Univ. of Guelph, Ontario (Canada)); Willutzki, H. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The authors summarize the Hybrids, Exotics, and Dibaryon section. They begin with a brief discussion of hybrid properties and some comments on $qq\bar{q}\bar{q}$ states and dibaryons. The bulk of this summary is devoted to discussion of the interesting results reported in these sessions; the GAMS $1^{-+} \rightarrow \eta\pi^0$ state, the Lepton-F $C(1480) \rightarrow \phi\pi^0$ state, various $\gamma\gamma \rightarrow VV'$ results, and the CERN WA62 $U(3.1) \rightarrow \Lambda\bar{p}\pi^+\pi^-$ state along with theoretical interpretations of these results. It is concluded with some comments on future directions in exotic hadrons. 56 references, 7 figures, 1 table.

41135 (CONF-8905143–7) **Two-photon process and anomalous electron-pair production in πp collisions.** Ernst, D.J.; Albert, C.J.; Bottcher, C.; Strayer, M.R. Oak Ridge National Lab., TN (USA). 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From NATO international advanced courses on the nuclear equation of state; Peniscola (Spain); 12 May - 3 jun 1989. Order Number DE89015354/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The two-photon mechanism for lepton-pair production is calculated in a nonconventional way by treating the relative pion-nucleon motion in the classical limit. The results are compared with existing data for anomalous e^+e^- pairs produced in the collision of 16 GeV/

c pions with protons. The results for differential cross sections as a function of the invariant pair mass, Feynman x, and transverse momentum are found to be in reasonable agreement with the data. The dominant piece of the cross section arises from the magnetic, spin-flip part of the nucleon current. 14 refs., 4 figs.

41136 (CRN-HE-88-09) **Photoproduction of the D meson: study of the D^0 -> $K^-\pi^+\pi^0$ channel, characteristics of charm hadronization and production dynamics.** Foucault, P. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 132p. (In French). Order Number DE89903314/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Data from events retained by a charm filtering program applied to 17 million raw data are used to show the decay signal D^0 -> $K^-\pi^+\pi^0$. Forty D^0 from the decay D^{*+} were observed. The ratio of the D^{*+} and D^0 production rates was calculated. Results from two methods for correcting acceptance and efficiency resemble the usual ratio of vector and scalar production, i.e., 3. The ratio R of the production rates of charged and neutral D is R = 0.57 $\pm$ 0.08 $\pm$ 0.10. Comparison of the ratios D^+/D^0 (R1) and D^-/D^0 bar (R2) shows the difference in the hadronization process between baryonic and mesonic strings. The result of the comparison R1/R2 = 0.8 $\pm$ 0.17 agrees with simulations, which predict a value of 0.86. The xF distribution of D^0 detected in the $K^-\pi^+$ channel agrees with predictions of the first order QCD quark-gluon fusion model associated with Lund hadronization.

41137 (DOE/ER/01112-14) **Studies of elementary particles: Progress report.** Michigan Univ., Ann Arbor, MI (USA). Dept. of Physics. 16 May 1989. 86p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01112. Order Number DE89014859/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Some task highlights discussed in this report are: Task B has completed and successfully operated 8 Michigan muon array patches for the UMC experiment; The Task C built luminosity monitor for the MarkII detector is functioning well and fulfilling its key role in the determination of the Z mass and width; Major Task C contributions to the machine diagnostics, the beamstrahlung monitor and wire scanner, have provided critical tuning information for the SLC; Task E (γ^*) has recently reported the detection of 200 GeV γ-rays from the Crab Nebula with a statistical significance of 5.8 σ. This observation confirms the importance of imaging techniques for VHE γ-ray astronomy; The Michigan theory group (Task G) has focused on: Working to understand the systematics of gluon dynamics in poorly understood pseudoscalar meson decays, Exploring the consequences of heavy Higgs boson and/or a top quark more massive than the $W^\pm$ or Z, Surveying the potentially attractive ways of experimentally searching for the Higgs boson of the minimal Standard Model or the spectrum of Higgs bosons to be expected in extensions of the Standard Model, Calculating the radiative corrections for W^+W^- -> W^+W^- as a precision test of the Standard Model, especially in its sensitivity to the Higgs sector, Investigating the modifications of general relativity arising from quantum fluctuations of matter, Exploring phenomenological test of CP violation dynamics, Developing relations between the strong CP problem and ElectroWeak CP violation, and Investigating 4-Fermi interactions in Technicolor models.

41138 (DOE/ER/01428-T1) **An experimental high energy physics program: Task A: Progress report, January 1988-May 1989.** Gaidos, J.A.; Loeffler, F.J.; McIlwain, R.L.; Miller, D.H.; Palfrey, T.R.; Shibata, E.I. Purdue Research Foundation, Lafayette, IN (USA). 1 May 1989. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01428. Order Number DE89014695/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The CLEO detector accumulated, (~480,000 B-mesons) the world's largest sample of B decays, before being shutdown in May 1988 for the installation of CLEO II. This data sample came from 335 pb^{-1} accumulated at the Υ(4S). The Cornell Electron Storage Ring set new luminosity records, reaching 3.5 pb^{-1} in a single day. These data are being intensively analyzed and 21 papers were given at the Baltimore APS meeting. Among the highlights are: confirmation of $B^0\bar{B}^0$ mixing; discovery of the charm-strange baryon Ξ_c^0; limits on b -> u decay; and non-observation of B -> $p\bar{p}\pi(\pi)$, which was reported by the ARGUS collaboration. The construction of CLEO II is proceeding on schedule. The new 1.5 T superconducting magnet has passed all tests and all of the detector elements have been installed. This includes a 7800 CsI crystals electromagnetic shower calorimeter. The data from the Gamma Ray Astrophysics experiment show a significant signal for high energy gamma ray emission from Cygnus X-3 and also confirm the previously reported anomalous period from Her X-1. Meanwhile, the old 6 mirror telescope has been refitted with 26 high resolution mirrors and improved fast electronics. GRANDE, the next generation detector based on the water Cherenkov technique, has been formally proposed to HEPAP. The detector will search for neutrino emission in the southern hemisphere and gamma radiation in the northern hemisphere.

41139 (DOE/ER/01428-T4) **An experimental high energy physics program within the Department of Physics, Purdue University, West Lafayette, Indiana: Progress report for the period ending May 15, 1989.** Barnes, V.E.; Carmony, D.D.; Garfinkel, A.F.; Gutay, L.J.; Koltick, D.S. Purdue Univ., Lafayette, IN (USA). Dept. of Physics. 1989. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01428. Order Number DE89012683/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the Collider Detector at Fermilab and Search for a Deconfined Quark-Gluon Phase of Strongly Interacting Matter at the FNAL $\bar{p}$-p Collider.

41140 (DOE/ER/01428-T5) **An experimental high energy physics program: Annual progress report: Task E.** Koltick, D.S. Purdue Research Foundation, Lafayette, IN (USA). 1 May 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01428. Order Number DE89012682/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses experiments at triston storage ring. Topics discussed are: Physics results; TOPAZ upgrade; the vertex chamber; and resources.

41141 (DOE/ER/01428-T7) **Status of the major upgrade to the High Energy Computer Facility for 1989.** Shibata, E.I. Purdue Univ., Lafayette, IN (USA). Dept. of Physics. 1 May 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01428. Order Number DE89015048/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper briefly discussed the following topics: Collider Detector at Fermilab; CLEO at Cornell; CO experiment at Fermilab and Gamma Ray Astronomy.

41142 (DOE/ER/13065-582) **[Research in experimental and theoretical high energy physics]: [Annual technical progress report].** Bodek, A.; Ferbel, T.; Melissinos, A.C.; Olsen, S.; Slattery, P.; Das, A.; Hagen, C.R.; Mathur, V.; Okubo, S.; Rajeev, S.G. Rochester Univ., NY (USA). Dept. of Physics and Astronomy. 15 Jun 1989. 174p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER13065. Order Number DE89014890/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The Experimental High Energy Physics Program is directed toward the execution of experiments at both national and international accelerator facilities. During the next fiscal year, we will be primarily concentrating on the following projects: Fermilab direct photon experiment E706; Tevatron proton-antiproton collider experiment D-Zero; Analysis of Fermilab neutrino experiments and hadron experiment; Analysis of SLAC experiment E140 and all previous SLAC data; Running of the SLAC E140 extension (approved to run in 89/90); SLAC experiment NE11 (ran in 1989); Brookhaven galactic axion experiment; Coherent production of axions and Delbruck scattering at BNL; The AMY experiment at TRISTAN; and Laser Switched LINAC at the Rochester Laser Laboratory. Projects which are in the completion stages: Search for new states of matter using the Rochester Tandem and SLAC experiment E141 Axion search. Projects in study and planning stages: Nonlinear Compton Scattering at LEP; Production of hybrid mesons in the nuclear coulomb field; Neutrino experiment for the Tevatron upgrade and the SSC; and Involvement in the CDF upgrade and the SSC.

41143 (FRCEA-TH-88) **Neutron-proton elastic diffusion study at low transfer between 400-1000 MeV.** Wellers, F. Paris-11 Univ., 91 - Orsay (France). Jan 1986. 141p. (In French). Order

Number DE89903163/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

This thesis presents the first complete results of forward differential cross-section, over the entire range of the intermediate energies, in the neutron-proton system. The neutron beam is produced with the synchrotron Saturne II, using the reaction of deuteron break-up, which gives it a relatively high intensity and a small energy dispersion. The experimental apparatus is a drift ionization chamber, IKAR, filled with high pressure gas which plays the double role of target and detector of the recoil proton. The use of a neutral beam requires new procedures in the analysis, more elaborate than in the case of charged projectiles, where scattered particles were detected in coincidence in wire chambers. The results are then normalized and discussed, using a phenomenological parametrization, and integrated in a continuously energy-dependent phase-shifts analysis. An entirely analytic Glauber calculation allows us to estimate the validity of the normalization method.

41144 (IPNO-DRE–88-23) **Status of narrow multibaryonic resonances studies.** Tatischeff, B.; Willis, N.; Comets, M.P.; Le Bornec, Y. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 10p. (CONF-8806225–: 9. international seminar on high energy physics problems relativistic nuclear physics and quantum chromodynamics, Dubna (USSR), 14-19 Jun 1988). Order Number DE89903216/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Experimental evidence for narrow structures at well defined masses in the T = 1 dibaryon sector is discussed. The evidence is not strong enough for the T = 0 or 2 dibaryons and for tribaryons. Experimental requirements needed in order to better understand the structures, e.g., angular distributions for excited T1 baryons and experiments in pure T = 0, 2, and 3 states and in the tribaryon sector, are summarized. Theoretical studies are needed to specify masses and widths of multibaryonic states, as well as dynamical calculations of the relative size of the multibaryon signal and of the background to explain why the structures appear for different reactions and incident energies. Narrow structures are really observed. Their identification with quark degrees of freedom remains the simplest explanation.

41145 (IPNO-DRE–88-35) **Three body mechanisms in hadron collisions. The A = 3 system.** Frascaria, R. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 9p. (CONF-8806236–: 1. European workshop on hadronic physics in the 1990's with multi-GeV electrons, Seillac (France), 27 Jun - 1 jul 1988). Order Number DE89903217/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Three-body mechanisms in hadron collisions, and the role of the A = 3 system are reviewed, and the excitation functions of the proton deuteron system in interactions at energies up to 2.9 GeV are discussed. Meson productions at large angles reveal structures due to the mesonic degrees of freedom in the interaction of the proton with the deuteron, exciting n* isobars in intermediate states. Propagation in the nuclei does not seem to change the properties of these isobars. The meson double scattering mechanism provides a way to understand coherent meson production in pd capture. It is difficult to say whether this coherent process corresponds to eigenstates of the A = 3 system. The sharing of the momentum transfer between the three nucleons renders impossible the observation of high momentum components in coherent proton captures. The possible contribution of the electromagnetic probe in hadron physics with a multi GeV electron accelerator is mentioned.

41146 (JINR-E–1-88-669) **Energy dependence of the total cross section for negaton-positon pair creation by gamma quanta in liquid xenon, measured in bubble chambers.** Strugalski, Z.; Alrohian, M.; El-Sharkawy, S. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 3p. Order Number DE89618958/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Energy dependence of the cross section is determined experimentally for production of electron-positron pairs by gamma quanta in liquid xenon at energies from about 10 MeV up to about 2000 MeV. 9 refs.; 1 fig.

41147 (LAL–8816) **Nuclear disintegration modes research with missing antineutrino in the Frejus detector.** Bourdarios, C. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; Paris-11 Univ., 91 - Orsay (France). Jun 1988. 219p. (In French). Order Number DE89903162/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The Frejus detector is a 900 tons fine grained calorimeter built in order to look for nucleon decay. It has reached a fiducial sensitivity of 1.3 kt. year after four years of data taking. In this thesis the decay modes with a missing anti-neutrino and one meson are studied. The analyses of all the meson decay channels are described, in particular those where the final state involves only photons or a muon due to K^+ decay. The topological and kinematical cuts are different for all the channels; the detection efficiency computed by Monte -Carlo simulation ranges from 10% to 16%. The background is due to atmospheric neutrino interactions in the detector, and is estimated from a simulation. Data are consistent with the calculated background, which is smaller or close to one event per decay channel. Lower nucleon lifetime limits are obtained, which range from 0.9 10^{31} to 2.9 10^{31} years.

41148 (LBL–27411) **Production of lepton pairs at the LBL Bevelac.** Roche, G. Lawrence Berkeley Lab., CA (USA). Jun 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8905143–5: NATO international advanced courses on the nuclear equation of state, Peniscola (Spain), 12 May - 3 jun 1989). Order Number DE89015234/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We discuss the physics objectives for the DLS program with some emphasis on the possible use of dileptons as a probe of pion dynamics in nuclear matter. Data on p-Be reactions at 1-5 GeV and Ca-Ca at 1-2 A GeV are presented. The observation of a structure at about twice the pion mass in the e^+e^- invariant mass spectra above 2 GeV beam energy and the excitation function for the p-Be reaction suggest that pion annihilation is a significant dielectron source above 2 GeV. The dielectron mass spectrum from Ca-Ca at 1 A GeV exhibits an inverse slope larger than the one from p-Be at the same beam energy. 22 refs., 12 figs., 3 tabs.

41149 (LPNHEP–88-10) **Photon structure function measurement at low Q^2, with CELLO detector.** Blohm, K.H. Paris-7 Univ., 75 (France). Dec 1988. 111p. (In French). Order Number DE89903175/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

This thesis describes an experimental study of the photon structure function using the CELLO detector. After a brief description of the complete CELLO detector we introduce the theoretical context and present a simulation program of the forward detector, which is an essential part of the CELLO detector for this analysis. This simulation program is tested and used in order to calculate an absolute normalisation of the results of this measurement by small angle Bhabha scattering. The last chapter of this thesis presents the selection criteria for events with a hadronic final state. Detector effects are corrected by an unfolding procedure and the results of this measurement are shown. Finally, using the structure function formalism for events with a leptonic final state we check the validity of the hadronic measurement and the normalisation. The essential physical results of this thesis are an indication for scale violation at low Q^2 and the inadequacy of the standard theoretical predictions (VDM and QPM) at low Q^2.

41150 (SLAC-PUB–4990) **Neutrino counting with the SLD at the Stanford Linear Collider.** Band, H.; Bugg, W.; Chadwick, G.; Coyne, D.; Gyure, M.; Hertzbach, S.; Messner, R.; Mincer, A.; Mockett, P.; Nauenberg, U. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8902110–3: 2. international symposium on the 4th family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989). Order Number DE89013892/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One of the fundamental measurements to be made at the e^+e^- colliders, SLC and LEP, is the determination of the number of neutrino families produced in Z^0 boson decays. In the event that a fourth generation of light Dirac neutrinos exists, the experimental consequences at the Z^0 resonances are easily seen; the total width

will be increased by 171 MeV over its three generation value, to be compared to the ≈30 MeV precision that should be achievable once the systematic limit has been reached. A reasonable figure of merit for the precision of a neutrino counting measurement of 0.2 standard model generations corresponds to a Z^0 width measurement error of 35 MeV; close to the limit of anticipated experimental capability. In fact, it is highly desirable to achieve an even higher precision if possible, in order to distinguish potentially small effects due to exotic phenomena from beyond the Standard Model. This paper will address the issue of how to obtain the best measurement of the number of neutrino generations as a function of the size of the available sample of Z^0 decays. The results presented here were obtained by our study group in an attempt to understand the limitations of a realistic neutrino counting measurement with the SLD at the Stanford Linear Collider. However, many of our findings are general enough to be applicable to any e^+e^- detector designed to take data at the Z^0 resonance. 19 refs., 5 figs., 6 tabs.

41151 (SLAC-PUB-5013) **Tests of quantum chromodynamics in exclusive and inclusive electroproduction.** Brodsky, S.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8901115-5: Topical conference on electronuclear physics with internal targets, Stanford, CA (USA), 9-12 Jan 1989). Order Number DE89013984/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: overview of electroproduction phenomenology; hadronization of the quark and spectator systems; hadronization in nuclei; shadowing and anti- shadowing; color transparency; exclusive channels in electroproduction; hadronic wavefunction phenomenology; diffractive electroproduction; exclusive nuclear processes in QCD; and relation of electroproduction to QCD wavefunctions. 58 refs., 22 figs. (LSP)

41152 (UCID-21399) **Forward Raman gain suppression by Stokes-anti-Stokes coupling.** Murray, J.R.; Karr, T.J. Lawrence Livermore National Lab., CA (USA). 4 Jan 1989. 21p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. MIPR-W31-RPD-63-A072. Order Number DE89013980/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We present a simple plane-wave model of Raman gain suppression for off-axis Stokes and anti-Stokes beams propagating in a finite-diameter pump beam. Gain per unit length increases off axis as the Stokes becomes mismatched to the anti-Stokes. The total path length with gain decreases off axis due to the finite beam. The angles of maximum total gain and of maximum Stokes intensity over threshold is a function of the gain over a distance of one wavelength. This model is applied to the case of stimulated rotational Raman scattering of free-electron laser pulses off N_2 in the atmosphere. The Stokes-anti-Stokes coupling does not significantly extend the propagation range of steady-state pulses abovethreshold. Stokes-anti-Stokes coupling causes significant gain suppression for phase-matched rays propagating near the beam axis, but, for interesting beam geometries and intensities over the steady-state threshold, the weakly suppressed off-axis rays have much higher gain and reach threshold in a short distance. Including diffraction of transient Raman effects in the analysis might make the gain suppression a little more effective. 11 refs., 7 figs., 1 tab.

41153 (UCID-21662) **Model for transient stimulated molecular Raman scattering.** Karr, T.J. Lawrence Livermore National Lab., CA (USA). 20 Feb 1989. 27p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. Order Number DE89013978/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The theory of transient stimulated Raman scattering is developed for a molecule with nondegenerate initial and final states. The general coupled Maxwell-Bloch equations describing this case are presented for an arbitrary number of Stokes and anti-Stokes fields, including effects of ac Stark shift, transient refractivity, saturation, and phase mismatching. Various common cases are examined, leading to simpler equations of field propagation and molecular evolution. In the case of only pump and first Stokes fields in dispersionless medium, the Stokes will stably phase lock to the pump when (a) Stokes is increasing, but still smaller than the pump, and (b) Stokes is decreasing, but still larger than the pump. Inhomogeneous broadening is described by an ensemble of scattering molecules. The ensemble-averaged Bloch equation is formally solved to give the Raman source as a convolution of the ensemble distribution with the homogeneously broadened density matrix. The couple scattering of an arbitrary number of Stokes and anti-Stokes fields is compactly described by a unitary transformation among suitably normalized field envelopes, with the antihermitean "gain operator" a function of the density matrix and the phase shifts. 9 refs., 2 tabs.

41154 Hadroproduction of the iota meson observed in the $K_sK_s\pi^0$ final state. Cason, N.M.; Bensinger, J.R.; Bishop, J.M.; Biswas, N.N.; Busenitz, J.K.; Etkin, A.; Foley, K.J.; Fortner, M.R.; Fortney, L.R.; Goo, J.; Goshaw, A.T. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989).

Results from an experiment studying the C=+1 $K_sK_s\pi^0$ system produced in π^- interactions at 21.4 GeV/c are presented. It is shown that the structure present in the data between 1.4 and 1.5 GeV/c^2 has mass and width consistent with the ι(1460) observed in J/ϕ radiative decay and most probably has $J^{PC} = 0^{-+}$. 19 references, 7 figures, 1 table.

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Refer also to citation(s) 40703, 41027, 41029, 41092, 41093, 41099, 41114, 41131, 41133, 41134, 41151, 41152, 41153, 41192, 41253, 41254, 41322

41155 (BNL-42650) **Testing the viability of the E_T^{miss} signature in gluino production at the SSC.** Barnett, R.M.; Freeman, J.; Raja, R.; Gunion, J.F.; Haber, H.E.; Hollebeek, R.; Paige, F.E.; White, A.P. Brookhaven National Lab., Upton, NY (USA); Lawrence Berkeley Lab., CA (USA); California Univ., Davis, CA (USA). 1988. 11p. Sponsored by DOE/ER;OGA. DOE Contract AC02-76CH00016;AS03-80ER70191;AC03-76SF00098. PHY83-18358. (LBL-26288;UCD-88-30;SCIPP-88/38;CONF-8806243-44: DPF summer study: Snowmass '88: high energy physics in the 1990s, Snowmass, CO (USA), 27 Jun - 15 jul 1988). Order Number DE89015113/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We report on a preliminary study at SSC energies of signatures and backgrounds for heavy gluinos in the minimal supersymmetric extension of the Standard Model. Unlike previous studies we account for the small branching ratio of gluinos to the lightest supersymmetric particle. We find that an E_T^{miss} signature is observable over the Standard Model background.

41156 (BNL-42853) **Higgs boson hunting.** Dawson, S.; Haber, H.E.; Rindani, S.D. Brookhaven National Lab., Upton, NY (USA). May 1989. 25p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8901127-3: Workshop on high energy physics phenomenology, Bombay (India), 2-15 Jan 1989). Order Number DE89015106/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This is the summary report of the Higgs Boson Working Group. We discuss a variety of search techniques for a Higgs boson which is lighter than the Z. The processes $K \to \pi H$, $\eta' \to \eta H$,$Y \to H\gamma$ and $e^+e^- \to ZH$ are examined with particular attention paid to theoretical uncertainties in the calculations. We also briefly examine new features of Higgs phenomenology in a model which contains Higgs triplets as well as the usual doublet of scalar fields. 33 refs., 6 figs., 1 tab.

41157 (BNL-42854) **A primer on Higgs boson low-energy theorems.** Dawson, S.; Haber, H.E. Brookhaven National Lab., Upton, NY (USA). May 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8901127-2: Workshop on high energy physics phenomenology, Bombay (India), 2-15 Jan 1989; SCIPP-89/14). Order Number DE89015157/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We give a pedagogical review of Higgs boson low-energy theorems and their applications in the study of light Higgs boson interactions with mesons and baryons. In particular, it is shown how

to combine the chiral Lagrangian method with the Higgs low-energy theorems to obtain predictions for the interaction of Higgs bosons and pseudoscalar mesons. Finally, we discuss the relation between the low-energy theorems and a technique which makes use of the trace of the QCD energy-momentum tensor. 35 refs.

41158 (BNL–42932) **A new string model (VENUS 2) for hadronic collisions based on color exchange between quarks and antiquarks.** Werner, K. Brookhaven National Lab., Upton, NY (USA). May 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8903143–2: 24. Recontres de Moriond: new results in hadronic interactions, Les Arcs (France), 12-18 Mar 1989). Order Number DE89015097/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We describe the latest version of the string model VENUS, taking also into account antiquarks as participants in the color exchange (string flip) process, the basic mechanism to form strings. An important consequence is a rapidity plateau for protons and lambdas in symmetric heavy ion collision contradicting the assumption of transparency. 10 refs., 7 figs.

41159 (BONN-ME–89-03) **A relativized quark model for radiative baryon transitions.** Warns, M.; Schroeder, H.; Pfeil, W.; Rollnik, H. Bonn Univ. (Germany, F.R.). Physikalisches Inst. Mar 1989. 23p. Order Number DE89795105/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In this paper we investigate the electromagnetic form factors of baryons and their resonances using the framework of a relativized constituent quark model. Beyond the usual single-quark transition ansatz, we incorporate relativistic corrections which are well-determined by the intrinsic strong interaction and confinement forces between the quarks. Furthermore we separate off for the compound three-quark system the relativistic center-of-mass motion by an approximately Lorentz-invariant approach. In this way for the first time recoil effects could be explicitly studied. Using the harmonic oscillator wavefunctions with the configuration mixing as derived in the Isgur-Karl model, after restoring gauge invariance our relativized interaction hamiltonian can be used to calculate the transversely and longitudinally polarized photon transition form factors of the baryons. (orig.).

41160 (BONN-ME–89-04) **Calculations of electromagnetic nucleon form factors and electroexcitation amplitudes of isobars.** Warns, M.; Schroeder, H.; Pfeil, W.; Rollnik, H. Bonn Univ. (Germany, F.R.). Physikalisches Inst. Mar 1989. 36p. Order Number DE89795106/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In this paper, we present numerical results for electroproduction amplitudes of proton resonances and electromagnetic nucleon form factors calculated in a relativized quark model. Interactions with both transversely and longitudinally polarized virtual photons were considered. Contributions of the different effects included in our approach have been analysed through a sample comparison with the available data. We also discuss the validity of the usual single-quark transition ansatz and possible parametrizations of the potential acting between the constituent quarks of the baryon. Impressive agreement is obtained with the nucleon form factor data up to squared momentum transfers of 2.5 GeV^2, but still some problems remain with the $\Delta(1232)$ and higher resonances. (orig.).

41161 **Hadron spectroscopy: an overview with strings attached.** Isgur, N. (Univ. of Toronto, Ontario (Canada)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

After describing some recent progress in understanding the status of the quark model within QCD, the author suggests a picture for the ordinary hadrons, hybrids, and glueballs which provides a simple framework for studying these elements of hadron spectroscopy. Within the same picture, he discusses multiquark states, emphasizing their importance for understanding glue dynamics and, in a more practical context, nuclear physics. 40 references, 17 figures, 1 table.

41162 **Heavy flavors.** Koenigsmann, K. (Universitaet Muenchen (West Germany)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

This talk summarizes the current knowledge on the physics of the heavy flavor states $c\bar{c}$ and $b\bar{b}$. Their masses and decay widths can be used to derive information on the quark potential and on the coupling constant of the strong interaction. Radiative decays of heavy quarkonia to light mesons allow an investigation of known low mass states and a search for new forms of matter: glueballs, hybrids and four quark states. 60 references, 6 figures, 1 table.

41163 **Gluonium(gg), glue ball (ggg) and hybrid ($gq\bar{q}$) states.** Bhatnager, S. (Univ. of Delhi (India)); Mitra, A.N. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The mass locations of low lying gg, ggg and $gq\bar{q}$ states are suggested in a parameter-free fashion within a QCD oriented Bathe-Salpeter model of confinement which correctly predicts the mass spectra of $q\bar{q}$ and qqq states as well as several types of transition amplitudes. 30 references.

41164 **Identification of θ ($f_2(1720)$) as a tensor glueball.** Liu, K. (Univ. of Kentucky, Lexington (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract FG05-84ER40154. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The energy-momentum tensor matrix element for the tensor glueball is obtained from the tensor dominance model. Branching ratio of $\theta(f_2(1720))$, in J/ψ radiative decay is calculated which agrees with the observed experimental branching ratio. The decay modes of θ ($f_2(1720)$), the suppression of θ in $K^-p \rightarrow \Lambda K_s^0 K_s^0$ as well as its emergence in the central production of $\pi p \rightarrow \pi K^+K^-p$ and $pp \rightarrow pK^+K^-p$, and the results from $J/\psi \rightarrow \gamma KK$, ωKK, and $\phi K\bar{K}$ are taken as good indications for flavor independence of the tensor meson θ. Absence of θ ($f_2(1720)$) in $\gamma\gamma$ reaction and $K^-p \rightarrow \Lambda K_s^0 K_s^0$ are considered as evidence for the fact that there are no quarks in θ. From the combined theoretical and experimental studies, it was concluded that θ is indeed a rather pure glueball. 14 references.

41165 **Possible non-observability of glueballs and hybrids.** Peaslee, D.C. (Univ. of Maryland, College Park (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

It is argued on a qualitative model that glueballs may have intrinsic widths $\Gamma_G \sim 1$ GeV and will distribute themselves over ~ 10 ordinary $q\bar{q}$ states within that compass. This means that the average glueball component of a $q\bar{q}$ state is of order 10%; in a specific example no $q\bar{q}$ state had more than a 30% admixture of glue. The argument generalizes at once to hybrids: e.g., systems such as $q\bar{q}G$ dispersing themselves among an even greater number of $qq\bar{q}\bar{q}$ states. 1 figures.

41166 **New results on D/f_1 (1285) and ι/η(1440) from DM2.** Stanco, L. (I.N.F.N., Padova (Italy)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Preliminary results from Partial Wave Analysis on the D/f_1(1285) region in the $J/\psi \rightarrow \gamma 4\pi^{\pm}$ decay, and the ι/η(1440) seen in the $J/\psi \rightarrow \gamma K\bar{K}\pi$ decays are presented. In the first channel the PWA excludes a η(1275) contribution, so supporting the f_1 identification for the observed peak. A clear pseudoscalar signal is evidenced in the $K\bar{K}\pi$ mass spectrum decaying via δ/a_0 (980) as well as K^*(892) dynamics. Its width is smaller than in the total spectrum, two other contributions, a narrow (less than 30 MeV/c^2) 1^{++} peak at 1395 MeV/c^2 which decays into $\delta\pi$ and a shoulder at 1515 MeV/c^2 observed in the direct 3-body decay $K\bar{K}\pi$, being present. The shoulder might have a spin-parity 1^{++} even if within strong statistical limitations. 18 references, 8 figures.

41167 Overview of hybrid meson phenomenology. Godfrey, S. (Univ. of Guelph, Ontario (Canada)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Models of hadrons based on quantum chromodynamics predict new forms of hadronic matter, referred to as hybrids, with both quarks and excited glue degrees of freedom. Theoretical models of hybrids and reviewed with the aim of finding features of hybrids which transcend specific models. The goal is to find signatures that can distinguish between hybrids and conventional hadrons. 33 references, 3 figures, 2 tables.

41168 $K\bar{K}$ molecules. Weinstein, J. (Univ. of Tennessee, Knoxville (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The authors briefly reviews the history of $qq\bar{q}\bar{q}$ physics and sketch the Non-Relativistic Quark Model (NRQM). He then outlines the analysis of $qq\bar{q}\bar{q}$ systems in the NRQM and discuss the extraction of meson-meson potentials and their effects on meson-meson systems. He concludes that the S^* (975) and $\sigma(980)$ scalars are $K\bar{K}$ bound states and show that experiment supports this assignment. 25 references.

41169 Does the η meson bind to other hadrons?. Rosen, J.L. (Northwestern Univ., Evanston, IL (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-76ER02289. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The constituent quark model has had great success in describing the properties of the basic mesons ($Q\bar{Q}$) and baryons (Q^3). Bound states with larger numbers of valence quarks such as Q^2Q^{-2}, Q^3Q^{-3} and Q^4Q^{-4} have also been predicted. The possibility that the η meson binds to nuclei has been addressed both theoretically and experimentally. An important caveat concerning the composite nature of the η meson is pointed out and discussed. 3 references.

41170 Exotic mesons. Close, F.E. (Oak Ridge National Lab., TN (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC05-84OR21400. From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

This paper discusses the status of exotic mesons - states that do not fit into the simple $q\bar{q}$ model. 17 references, 1 figure.

41171 Glueball in the anomalous J/ψ and ψ' decays?. Toernqvist, N.A. (Univ. of Helsinki (Finland)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Recently Brodsky, Lepage and Tuan have suggested the existence of a narrow vector glueball very near to the J/ψ in order to explain the remarkable empirical fact that the ratios of branching ratios for ψ' and J/ψ to $\pi\rho$ and $K\bar{K}^*$ are an order of magnitude smaller than expected from perturbative QCD. It is shown that the data can also be understood if nonperturbative effects, parametrized by a conventional hadronic form factor, are still operative at the J/ψ and ψ' masses. The same form factor also successfully describes the ratios of the $\phi \to \pi\rho$ width to that of $J/\psi \to \pi\rho$, where the effect from the form factor is much larger. 11 references, 4 figures.

41172 Radiative meson decays - an algebraic approach. Slaughter, M.D. (Los Alamos National Lab., NM (USA)); Oneda, S. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Radiative transitions between the ground state pure $q\bar{q}$ vector and pseudoscalar mesons are studied non-perturbatively using equal-time commutation relations (ETCRs) and the dynamical concept of asymptotic $SU_F(N)$ symmetry. A number of predictions are made including $\Lambda(D^{*0} \to D^0\gamma)$, $\Lambda(D^{*+} \to D^+\gamma)$, etc. In addition, hadronic partial widths of D^{*+} and D^{*0} are calculated. The importance of the $SU_F(N)$ singlet piece of the electromagnetic current when considering radiative decays and the experimental value of $\Lambda(K^{*0} \to K^0\gamma)/\Lambda(K^{*+} \to K^+\gamma)$ is pointed out. 6 references, 2 tables.

41173 Heavy mesons in a relativistic quarkonium model. Ito, H. (Kinki Univ., Higashi-Osaka (Japan)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The $c\bar{c}$ and $b\bar{b}$ systems are investigated by using the Bethe-Salpeter equation with the scalar confining and the one-gluon-exchange interactions. The flavor independence of $\Lambda_t/a_s m_q$ is assumed for the high-momentum cut Λ_t in the gluonic correction. Reasonable fine splittings of the $b\bar{b}$ system are obtained, besides good agreement of the lower $c\bar{c}$ masses with the experimental values. The masses of the unknown or nonestablished states are predicted. The leptonic widths of the vector mesons are estimated by using the renormalized wave function at the origin with a phenomenological cutoff. Good agreement with the experiments is achieved. 11 references, 1 figure, 2 tables.

41174 RG arguments and a calculation of $\Lambda(\Upsilon \to H\gamma$. Ryzak, Z. (Northeastern Univ., Boston, MA (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

The author presents results of a $O(a_s)$ calculation of $\Lambda(\Upsilon \to H\gamma)$ in the $\overline{MS}$ scheme. He argues that a recent analysis of the Υ data may imply a certain choice of scale parameter $\mu \sim 2m_b$, as opposed to previous calculations at $\mu \sim 0.5m_b$. At $\mu \sim 2m_b$ he predicts a lower bound on the mass of the Higgs particle m_H {>=} 4.5 GeV (or with new CUSB data m_H {>=} 5.5 GeV). 13 references, 1 figure.

41175 Heavy hadronic molecules. Rosen, J.L. (Northwestern Univ., Evanston, IL (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

Although compelling arguments have been advanced for interpreting a number of hadronic states as Q^2Q^{-2} cryptoexotics, it cannot be said that their existence is unequivocally established. Decisive demonstrations can be provided by the discovery of one or more states incorporating heavy quarks such as $D\bar{D}$, DK, or $D\bar{K}$. A phenomenological description of the physics of these states is given. The prospects for their production and detection will be discussed. Bound states of baryon-antibaryon will also bee discussed with examples such as $\Lambda\bar{\Lambda}$ and $\Lambda_c\bar{\Lambda}_c$. 12 references.

41176 (GSI–89-35(prepr.)) **Dispersion relation for hot gluonic matter from the BBGKY hierarchy.** Bozek, P.; Ploszajczak, M. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Apr 1989. 10p. Order Number DE89795122/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

We investigate the intrinsic consistency of the kinetic theory for hot gluons in the mean-field limit and, for that, we formulate the general kinetic equations and solve them near the equilibrium to find the dispersion relation in the order g^2. We also derive the equation for the equilibrium, meanfield distribution of gluons and show that this equation is not satisifed by the perturbative change of the equilibrium state of noninteracting gluons. Hence, we argue that the perturbative approximation to the equilibrium distribution of gluons is inconsistent with the kinetic equations already at the lowest, non-trivial order g^2. This suggests strong, non-perturbative effects at the scale proportional to gT. (orig.).

41177 (HU-TFT–87-15) **High temperature gluon matter in the background gauge.** Elze, H.T.; Heinz, U.; Kajantie, K.; Toimela, T. Helsinki Univ. (Finland). Research Inst. for Theoretical Physics. 15 May 1987. 21p. Order Number DE89632158/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The polarisation tensor of gluons in high temperature QCD matter is discussed in the background gauge and compared with that in the temporal axial $A_0 = 0$ gauge. In both of these the gluon polarisation tensor alone is sufficient to give the asymptotically free sign

of the QCD beta function. The the former the beta function and the imaginary part of the polarisation tensor are coupled in such a way that asymptotic freedom implies instability of plasma oscillations. In the latter, due to the non-covariance of the gauge condition, the beta function and the imaginary part are decoupled in such a way that the sign of the imaginary part corresponds to stable plasma oscillations.

41178 (HU-TFT–87-26) **Nucleon-nucleon spin-orbit interaction in the Skyrme model.** Riska, D.O.; Dannbom, K. Helsinki Univ. (Finland). Research Inst. for Theoretical Physics. 31 Jul 1987. 17p. Order Number DE89632159/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The spin-orbit and quadratic spin-orbit components of the nucleon-nucleon interaction are derived in the Skyrme model at the classical level. These interaction components arise from the orbital and rotational motion of the soliton fields that form the nucleons. The isospin dependent part of the spin-orbit interaction is similar to the corresponding component obtained from boson exchange mechanisms at long distances although at short distances it is weaker. The isospin independent spin-orbit component is however different from the prediction of boson exchange mechanisms and has the opposite sign. The quadratic spin-orbit interaction is weak and has only an isospin dependent component.

41179 (HU-TFT–87-27) **Associated production of intermediate mass Higgs particle with a large P_T jet at SSC energy.** Chaichian, M.; Liede, I.; Lindfors, J.; Roy, D.P. Helsinki Univ. (Finland). Research Inst. for Theoretical Physics. 27 Jul 1987. 16p. Order Number DE89632160/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We calculate the higher order Higgs particle production process gg-> gH for a large top quark mass ($2m_t > m_H$). We compute the resulting associated production cross-section for intermediate mass Higgs particle ($_W < m_H < 2m_W$) at SSC, followed by its dominant decay mode into a bottom quark pair. At large p_T the cross section becomes comparable to that of the QCD background while remaining sufficiently large for detection at SSC.

41180 (HU-TFT–89-22) **Excited hyperons in the Skyrme model.** Dannbom, K.; Nyman, E.M.; Riska, D.O. Helsinki Univ. (Finland). Research Inst. for Theoretical Physics. 26 May 1989. 8p. Order Number DE89632161/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In the Callan-Klebanov model, hyperons are bound states of skyrmeons and kaons. The model predicts, in addition to the well-established octet and decuplet, a definite set of excited states, among them the experimentally established $\Lambda(1405)$, which have no analogues in the non-strange sector. Experimental confirmations of the remaining ones of these states would establish the bound-state model as the correct approach towards hyperson spectroscopy. In its simplest version the model also predicts some exotic states. These may however disappear once the repulsive interactions between the kaons are taken into account.

41181 (JINR-E–2-88-493) **Novel mechanisms of baryon number flow over large rapidity gap.** Kopeliovich, B.Z.; Zakharov, B.G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 19p. Order Number DE89632174/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Z. Phys., C.

It is shown that slow valence quark in the wave function of high energy proton can fragment into a baryon if the fast diquark-spectator is disintegrated, i.e. is turned from the antitriplet to the sextet colour state. The cross section of the baryon number flow to the central rapidly region using the perturbutive QCD are estimated. It depends on the rapidly gap δ_y as $\exp(-\delta_y 2/)$ and nicely agrees with the data at ISR energies. There exists also an intriguing possibility of tranfering baryon number by means of gluonic exchanges only. This contribution does not depend on rapidity at all and becomes sizable in TeV energy region. New mechanisms for baryon-antibaryon production from vacuum, transfer of polarization over large rapidity intervals, and nuclear stopping power are propsed. 56 refs.; 11 figs.; submitted to Z. Phys., C.

41182 (JINR-E–2-88-518) **To the K^0_L and K^0_S-meson mass difference.** Avakyan, E.Z.; Avakyan, S.L.; Efimov, G.V.; Ivanov, M.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 6p. Order Number DE89632175/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Pis'ma Zh. Ehksp. Teor. Fiz.

The experimental value of the K^0_L and K^0_S-meson mass difference is shown to be explained in the standard model by taking into account the intermediate meson states, which effectively accumulate the performed in the quark confinement model. It is found that the contributions of 'small' and 'large' distances are equal to δm^{LD}=2,26x1015/GeV and δm^{SD}=1,45x10^{-15} GeV is good agreement with the experimental data. 16 refs.; 1 fig.; 1 tab.; submitted to Pis'ma Zh. Ehksp. Teor. Fiz.

41183 (JINR-E–4-88-471) **Proton polarizability correction to the proton-proton reaction.** Pupyshev, V.V.; Solovtsova, O.P. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 4p. Order Number DE89632176/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Phys. Lett., B.

In the framework of the phase function approach the contribution from electronic proton polarizability to the astrophysical factor S_{11} of the proton-proton reaction is found to be smaller than 2x10^{-4}%. 17 refs.; 1 tab.; submitted to Phys. Lett., B.

41184 (JINR-R–2-88-507) **Narrow one-channel resonances and their manifestation in the pure elastic scattering of unpolarized particles.** Lyuboshits, V.L. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 15p. (In Russian). Order Number DE89632177/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An energy dependence of the effective cross section of pure elastic resonance scattering in the presence of a constant background is investigated on the basis of the S-matrix unitarity condition. The relations are obtained which describe the range of changig the pure elastic scattering total cross section for non-identical as well as for identical particles in the passage through a narrow one-channel resonance.A finite width of the energetic resolution is taken into account. The results are applied to the analysis of the influence of narrow two-proton resonances on the elastic pp-scattering behaviour below the threshold of meson production. 11 refs.

41185 (LBL–27288) **The standard model and beyond.** Gaillard, M.K. Lawrence Berkeley Lab., CA (USA). May 1989. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (UCB-PTH–89/13;CONF-8903149–1: Trends in theoretical physics colloquia series, Minneapolis, MN (USA), 29 Mar 1989). Order Number DE89014887/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The field of elementary particle, or high energy, physics seeks to identify the most elementary constituents of nature and to study the forces that govern their interactions. Increasing the energy of a probe in a laboratory experiment increases its power as an effective microscope for discerning increasingly smaller structures of matter. Thus we have learned that matter is composed of molecules that are in turn composed of atoms, that the atom consists of a nucleus surrounded by a cloud of electrons, and that the atomic nucleus is a collection of protons and neutrons. The more powerful probes provided by high energy particle accelerators have taught us that a nucleon is itself made of objects called quarks. The forces among quarks and electrons are understood within a general theoretical framework called the "standard model," that accounts for all interactions observed in high energy laboratory experiments to date. These are commonly categorized as the "strong," "weak" and "electromagnetic" interactions. In this lecture I will describe the standard model, and point out some of its limitations. Probing for deeper structures in quarks and electrons defines the present frontier of particle physics. I will discuss some speculative ideas about extensions of the standard model and/or yet more fundamental forces that may underlie our present picture. 11 figs., 1 tab.

41186 (RAL–89-020) **Electromagnetic penguin contribution to ϵ'/ϵ for large top quark mass.** Flynn, J.M.; Randall, L.

Rutherford Appleton Lab., Chilton (UK). Apr 1989. 14p. (LBL–26857;UCB-PTH–89-3). Order Number DE89632178/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We evaluate the electromagnetic penguin contribution to ϵ' under the assumption that the top quark mass can be large. We find a significant effect for top masses larger than the mass of the W. We also consider other operators which can affect the standard model prediction for ϵ'. (author).

41187 (RAL–89-027) **Minijets, unitarity and multiple parton scattering.** Brown, N. Rutherford Appleton Lab., Chilton (UK). Apr 1989. 11p. Order Number DE89632179/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Multiple scattering of partons is an important prediction of the parton model in high energy pp-bar collisions, which can have a dramatic effect on the calculation of inclusive jet cross-sections at low transverse momenta. We discuss the implications of multiple scattering using a probability model, where it is found that at high energies the effects are extremely important in semi-hard processes, as well as being extremely sensitive to the shape of the gluon distribution within a proton. We give some examples at SSC energies. (author).

41188 (SLAC-PUB–5029) **Effects of W_R and charged Higgs in the leptonic decay of τ.** Tsai, Yung Su. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–2: Tau-Charm workshop, Stanford, CA (USA), 23-27 May 1989). Order Number DE89013983/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Experimental test of the existence of the right-hand W boson and the charged Higgs particle is suggested. The experiment involves measurement of muon polarization from the decay of polarized τ's. 8 refs., 2 figs., 1 tab.

6453 Particle Invariance Principles and Symmetries

41189 (CRN-PN–89-02) **Physics in the intrinsic coordinate frames with the universal mean field potential: spontaneous parity breaking and exotic shapes in high-spin states.** Dudek, J.; Joint Inst. for Heavy Ion Research, Oak Ridge, TN. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1989. 33p. Order Number DE89903225/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The concept of a "universal" average field as a basis of intrinsic-frame nuclear physics is stressed. The symmetries of such an average field are discussed. As an important application, an overwiew is given of the recent progress in understanding the octupole-type (intrinsic-parity breaking) degrees of freedom in nuclei. Their importance and the new consequences resulting from the related symmetries and spontaneous symmetry breaking phenomena are emphasized: the presence of static and/or dynamic isovector deformations and their implications, the possible low-energy E1 cooling in moderately hot nuclei at high spins, possible new forms of rotational dumping effects in rotating nuclei etc.

41190 (JINR-E–2-88-541) **Quantum N=3,4 superconformal WZW sigma models.** Ivanov, E.A.; Krivonos, S.O.; Leviant, V.M. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 12p. Order Number DE89631764/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Phys. Lett., B.

New Goldstone-type d=2 field representations of N=3,4 superconformal algebras (SA) are constructed. They exist both in classical and quantum regions and essentially involve the SO(3) and WZW currents. The multiplets found previously by Schoutens are purely quantum limiting case of ours. N=4 SA is shown to be extended by an operator central charge on the representations considered. 14 refs.; submitted to Phys. Lett., B.

41191 (LA-UR–89-1466) **Chiral symmetry and confinement.** Goldman, T. Los Alamos National Lab., NM (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8901131–1: Gell-Mann festschrift, Pasadena, CA (USA), 26-29 Jan 1989). Order Number DE89012598/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two principle features underlie the appearance of (approximate) chiral symmetry in hadronic systems. The first is that the conventional Dirac bispinor description of massless quarks hides the fact that this object is a direct sum of inequivalent representations of the Lorentz group. The second essential feature is that the dynamics must be chiral invariant as well. QCD satisfies this requirement by coupling equally to left and right chiral projections of the (nominally vector) color current ($V \pm A$) and so, to the separated components of the Dirac bispinor. The remainder of this paper describes these features.

41192 **Tunneling in many-fermion systems.** Negele, J.W. (Center for Theoretical Physics, Lab. for Nuclear Science and Dept. of Physics, Massachusetts Institute of Technology, Cambridge, MA (US)). vp. of Modern developments in nuclear physics. Sushkov, O.P. World Scientific Pub. Co., Teaneck, NJ (1988). (CONF-8706232–: International symposium on modern developments in nuclear physics, Novosibirsk (USSR), 27 Jun - 1 jul 1987).

A microscopic theory of barrier penetration is presented in which the dynamical path is determined self-consistently. The essential roles of Fermion nodal surfaces and symmetry breaking are emphasized. The theory is applied to a solvable pedagogical model, which demonstrates its quantitative accuracy and the importance of solving for the optimal collective path. Similar features are observed in a more realistic calculation of a 32-Fermion system in three dimensions.

41193 **Lectures on interacting string field theory.** Jevicki, A. (Brown Univ., Providence, RI (US)). vp. of Superstrings, anomalies and unification. Martinis, M.; Andric, I. World Scientific Pub. Co., Teaneck, NJ (1987). (CONF-8606383–: 5. Adriatic meeting on particle physics, Dubrovnik (Yugoslavia), 16-28 Jun 1986).

The authors give a detailed review of the current formulations of interacting string field theory. The historical development of the subject is taken beginning with the old dual resonance model theory. The light-cone approach is reviewed in some detail with emphasis on conformal mapping techniques. Witten's covariant approach is presented. The main body of the lectures concentrates on developing the operator formulation of Witten's theory.

41194 **BRST quantization of Kac-Moody algebras.** Bogojevic, A.R. (Dept. of Physics, Brown Univ., Providence, RI (US)); Hlousek, Z. vp. of Superstrings, anomalies and unification. Martinis, M.; Andric, I. World Scientific Pub. Co., Teaneck, NJ (1987). (CONF-8606383–: 5. Adriatic meeting on particle physics, Dubrovnik (Yugoslavia), 16-28 Jun 1986).

The authors apply the BRST quantization technique to current algebras in two dimensions (Kac-Moody algebras with central extensions) and show that nilpotency is satisfied only at a value of the central charge that makes the theory live in a sector without a lower bound in energy. No improvement is made by semi-direct coupling to the conformal algebra (Virasoro algebra). They explain how this problem is resolved by realizing that the root of the central charge of the Kac-Moody algebra is in the chiral anomaly. Taking the effect of the chiral anomaly into account allows for problem free quantization of the algebra. They also give an example of a system where this problem is absent.

6454 Field Theory

Refer also to citation(s) 41161, 41185, 41193, 41194, 41254

41195 **Status of lattice glueball mass calculations.** Schierholz, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988.

In this talk the author reviews the status of lattice glueball mass calculations. He restricts himself to recent results obtained on large lattices for the gauge group SU(3). 17 references, 3 figures.

41196 (DOE/ER/01428–T2) **A theoretical high energy physics program: Annual progress report for 1989: Task B.** Clark, T.E.; Kuo, T.K.; Love, S.T. Purdue Univ., Lafayette, IN

(USA). Dept. of Physics. 1989. 28p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01428. Order Number DE89012685/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report briefly describes the following research topics: aspects of dynamical symmetry breaking in gauge field theory; supersymmetric quantum electrodynamics and dynamical chiral symmetry breaking; anti-symmetric tensor gauge theories; extensions of the standard model; and neutrino oscillations in matter. (LSP)

41197 (DOE/ER/01428–T3) **A theoretical high energy physics program: Task C: Annual progress report for 1989.** Balazs, L.A.P.; Capps, R.H.; Fuchs, N.H. Purdue Research Foundation, Lafayette, IN (USA). 1989. 41p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01428. Order Number DE89012684/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our research interests have been mainly in the dynamics of hadrons and superstrings, the related domains of the mathematics of grand unified theories and problems related to the nature of phase transitions. Dynamical studies will include calculation of the effects of soft non-perturbative "string" loops, both in quantum chromodynamics and in superstring theory. Attempts will be made to find simple rules that will help both in understanding Kac-Moody algebras, particularly the affine algebras, and in performing manipulations with representations which arise in various theories of fundamental particles and their interactions. The foundations of chiral perturbation theory will be examined critically, and critical phenomena in lattice system will be studied with some newly developed numerical methods.

41198 (INIS-SU–98, pp. 92) **Spatial distribution of relativistic electron channeling γ-radiation.** Andreyashkin, M.Yu.; Zabaev, V.N.; Kashirin, A.P.; Konovalova, E.I.; Naumenko, G.A.; Potylitsin, A.P.; Tarasov, V.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRON CHANNELING/gamma spectra; GERMANIUM/electron channeling; AMORPHOUS STATE; CRYSTALS; GERMANIUM; MEV RANGE 100-1000; SPATIAL DISTRIBUTION; TEMPERATURE DEPENDENCE; THICKNESS

41199 (IPNO-TH–88-74) **Parametrization of the relativistic Dirac-Brueckner G-matrix.** Marcos, S.; Niembro, R.; Lopez-Quelle, M.; Malfliet, R.; Van Giai, N. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 33p. Order Number DE89903228/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A representation of the relativistic Brueckner G-matrix by an effective interaction Lagrangian is proposed. This Lagrangian contains the four mesons σ,ω,π (pseudo-vector) and rho(vector), with density-dependent coupling constants. It is shown that Dirac-Hartree-Fock calculations of nuclear matter using this effective interaction can reproduce well the results of the Dirac-Brueckner Hartree-Fock approach.

41200 (IPNO-TH–88-75) **Statistical aspects of the anyon model.** Comtet, A.; Georgelin, Y.; Ouvry, S. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Dec 1988. 15p. Order Number DE89903229/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The second virial coefficient for a gas of anyons is computed (i) by discretizing the two-particle spectrum through the introduction of a harmonic potential regulor (ii) by considering the problem in the continuum directly through heat kernel methods. In both cases the result of Arovas et al is recovered.

41201 (KFKI–1989-05/A) **Can solitons exist in non-linear chiral models constructed by the non-linear invariance principle.** Nguyen Ai Viet; Pham Thuc Tuyen. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 12p. Order Number DE89631671/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The old idea of Skyrme is reconsidered that soliton can be interpreted as baryons. Soliton stabilizing terms which contain only up to second order of field derivatives are introduced into the non-linearly invariant chiral models. These models will provide possibilities for modification of the Skyrme model based on the symmetry principle. (author) 10 refs.

41202 (KFKI–1989-06/A) **Non-linearly invariant Skyrme type model.** Nguyen Ai Viet; Pham Thuc Tuyen. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 13p. Order Number DE89631672/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In the simplest model that modifies the Skyrme model there exists a solitonic configuration which describes nucleons well, even with massive pion fields. The modification is that in the Lagrangian function, the nonlinearly invariant terms are neglected. The modified Skyrme model proposed here with massive pion fields gives better agreement with experiments in terms of static nucleon properties than the original model. (R.P.) 12 refs.; 3 tabs.

41203 (KFKI–1989-07/A) **Static properties of nucleons in a modified Skyrme model.** Nguyen Ai Viet; Pham Thuc Tuyen. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 14p. Order Number DE89631673/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A modified Skyrme type model is proposed by neglecting non-linearly non-invariant terms from the Skyrme's Lagrangian. It turns out that beside some additional advantages a hedgehog configuration of this model can quantitatively describe nucleons the same way as the skyrmion does in the usual Skyrme model. (author) 8 refs.; 2 figs.

41204 (KFKI–1989-08/B) **Factor structure of the Tomimatsu-Sato metrics.** Perjes, Z. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Feb 1989. 18p. Order Number DE89631674/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Based on an earlier result stating that $\delta = 3$ Tomimatsu-Sato (TS) metrics can be factored over the field of integers, an analogous representation for higher TS metrics was sought. It is shown that the factoring property of TS metrics follows from the structure of special Hankel determinants. A set of linear algebraic equations determining the factors was defined, and the factors of the first five TS metrics were tabulated, together with their primitive factors. (R.P.) 4 refs.; 2 tabs.

41205 (KFKI–1989-14/A) **Lessons from a time dependent model.** Balazs, Cs. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Mar 1989. 27p. Order Number DE89631675/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A particle is moving in an external field described by a stationary attractive potential and a time dependent repulsive potential. The dependence of the behaviour of a particle initially in a bound state on the parameters of the potential is studied, and the probability of staying in the bound state and the energy spectrum in case the particle escapes is calculated. It is shown that exact solutions of the time dependent Schroedinger equation can be found for separable potentials. The model has some physical applications, e.g., in the problems of heavy ion - heavy ion collisions and of laser induced emission in atomic and solid-state physics. (author) 3 refs.; 8 figs.

41206 (KFKI–1989-15/A) **Quark confinement and dynamical breakdown of chiral symmetry in covariant gauge QCD.** Gogokhia, V.Sh. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Mar 1989. 24p. Order Number DE89631676/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Phys. Lett., B.

Based on the widely accepted assumption that the full gluon propagator becomes an infrared singular like $(q^2)^{-2}$ at small momenta, the Schwinger-Dyson equation for the quark propagator,

completed by the corresponding Slavnov-Taylor identity was investigated in a gauge-invariant way. Three and only three confinement-type solutions were found for the quark propagator in the infrared region. A close connection between quark confinement and chiral symmetry breaking was established. It is stated that the ghost degrees of freedom play an essential role in the dynamics of chiral symmetry breaking. (author) 22 refs.

41207 (LPNHEP–89-01) **QED corrections to the forward backward asymmetry at LEP energies.** Campagne, J.E.; Zitoun, R. Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. 10p. Order Number DE89903227/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

A compact formula of the forward backward asymmetry A_{FB} is given. It is shown to reproduce all the presently known features on this quantity.

41208 (LYCEN–88-02) **Particle in a Coulomb or oscillator plus Aharonov-Bohm potential.** Kibler, M.; Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris; Negadi, T. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. 1988. 6p. (CONF-8806395–: 17. International colloquium on group theoretical methods in physics, Sainte-Adele, CA (USA), 27 Jun - 2 jul 1988). Order Number DE89903230/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Dynamical algebras for an Aharonov-Bohm plus Coulomb system are derived, mainly via the search for integrals of the motion. Some preliminary results for an Aharonov-Bohm plus oscillator system are also reported in this paper.

41209 (NIKHEF-H–89-4) **Theory of a charged spinning particle in a gravitational and electromagnetic field. Lecture at the Landelijk Seminarium 'Mathematische methoden in veldentheorie', December 12, 1986.** Holten, J.W. van. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. 13 Feb 1989. 13p. (CONF-8612176–: National seminar on mathematical methods in field theory, Amsterdam (Netherlands), 12 Dec 1986). Order Number DE89630142/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The classical and quantum mechanics of a charged spinning particle, such as an electron, in arbitrary gravitational and electromagnetic background fields is presented. The classical theory possesses supersymmetry. The equivalent Dirac formulation of the quantum theory is derived. (author). 10 refs.

41210 (RAL–89-008) **Lectures on relativistic quantum mechanics and path integration.** Gunn, J.M.F. Rutherford Appleton Lab., Chilton (UK). Feb 1989. 196p. Order Number DE89631677/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

The question posed is why bother with relativistic quantum mechanics? Three reasons are given: First that there are many experimental phenomena which cannot be explained in non-relativistic terms. Secondly it would be unsatisfactory if relativity and quantum mechanics could not be united. Thirdly, there are theoretical reasons why new effects can be expected at relativistic velocities. The objectives of the course are to set up relativistic analogues of the Schroedinger equation and to understand their consequences. In doing so there are some questions which are raised and discussed such as can a first order equation be used to describe spin 0 particles and a second order equation be used to describe spin 1/2 (author).

65 PHYSICS II

Refer also to citation(s) 40340, 40684

6510 Nuclear Physics

Refer also to citation(s) 41244, 41245

41211 (ANL/FPP/TM–241) **KAOS/LIB-V: A library of nuclear response functions generated by KAOS-V code from ENDF/B-V and other data files.** Farawila, Y.; Gohar, Y.; Maynard, C. Argonne National Lab., IL (USA). Fusion Power Program. Apr 1989. 419p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE89014375/JAW. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

KAOS/LIB-V: A library of processed nuclear responses for neutronics analyses of nuclear systems has been generated. The library was prepared using the KAOS-V code and nuclear data from ENDF/B-V. The library includes kerma (kinetic energy released in materials) factors and other nuclear response functions for all materials presently of interest in fusion and fission applications for 43 nonfissionable and 15 fissionable isotopes and elements. The nuclear response functions include gas production and tritium-breeding functions, and all important reaction cross sections. KAOS/LIB-V employs the VITAMIN-E weighting function and energy group structure of 174 neutron groups. Auxiliary nuclear data bases, e.g., the Japanese evaluated nuclear data library JENDL-2 were used as a source of isotopic cross sections when these data are not provided in ENDF/B-V files for a natural element. These are needed mainly to estimate average quantities such as effective Q-values for the natural element. This analysis of local energy deposition was instrumental in detecting and understanding energy balance deficiencies and other problems in the ENDF/B-V data. Pertinent information about the library and a graphical display of the main nuclear response functions for all materials in the library are given. 35 refs.

41212 (BNL-NCS–42989) **Finding nuclear data: The national nuclear data center.** Pearlstein, S. Brookhaven National Lab., Upton, NY (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906186–1: Materials Research Society materials analysis workshop, Albuquerque, NM (USA), 14-17 Jun 1989). Order Number DE89015108/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Nuclear reaction cross-sections and nuclear structure properties are useful for material analysis applications. The nuclear data requirements for material analysis overlap with the data requirements for other research fields, e.g., fission and fusion reactors, so that reference material may be used more widely than the original purpose in mind. The National Nuclear Data Center at Brookhaven National Laboratory, an outgrowth of data compilation and evaluation activities begun more than 40 years ago, specializes in indexing the bibliography, data compilation and data evaluation of nuclear reaction cross-sections and nuclear structure properties. Reference material that are available in many forms that include handbooks, data bases and on-line services are reviewed. 12 refs., 5 figs., 1 tab.

41213 (DOE/ER/40314–3) **Research in nuclear physics: Progress report, August 1, 1988–July 31, 1989.** Kozub, R.L.; Hindi, M.M. Tennessee Technological Univ., Cookeville, TN (USA). Dept. of Physics. Jul 1989. 44p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER40314. Order Number DE89015929/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report contains papers on the following topics: search for electromagnetic transitions in the neutron-rich nuclei ^{31}Al, $^{33-34}$Si, and ^{28}Mg via reactions of ^{18}O with ^{18}O; electromagnetic transitions in ^{43}K via the ^{9}Be(^{36}S,pnγ)^{43}K reaction; double K-shell vacancy production in the electron capture decay of ^{139}Ce; FIT2D: an interactive program for fitting peaks in two-dimensional spectra; and search for particle-bound neutral nuclei in heavy-ion-induced reactions.

41214 (DOE/ER/40315–161) **Experimental medium energy physics: Annual progress report, June 1988–May 1989.** Carnegie-Mellon Univ., Pittsburgh, PA (USA). 1989. 96p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER40315. Order Number DE89015015/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report discusses the following topics: search for the ξ(2230) at LEAR; hyperon-antihyperon production studies at LEAR; relativistic proton-nucleus and heavy ion-nucleus collisions at the SPS; search for the H dibaryon at the AGS; hypernuclear physics research; CEBAF activities; pion physics at PSI; and H particle experiment design and development.

41215 (GANIL-P–88-13) **Prospects for the study of exotic nuclei at Ganil.** Detraz, C. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 17p. (CONF-880795–: International symposium on heavy ion physics and nuclear astrophysical problems, Tokyo (Japan), 21-23 Jul 1988). Order Number DE89903303/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The many new results obtained at GANIL on nuclei far from stability in the recent years point to the interest and possibility of achieving spectroscopic studies for such unusual nuclear species. Their role in the r-process, the large probabilities that they exhibit for radioactive modes which are poorely known or even absent for nuclei closer to stability make this field of nuclear physics a natural ground for cooperation with astrophysics. The new developments planned at GANIL for the next two years should allow a further extension of these studies, typically by two more isotopes on the neutron-rich side. It is also worth noting that the development of radioactive beams and the use of GANIL for studying time-reversed reactions for the measure of cross sections of astrophysical interest present valuable possibilities which are only in their initial stage.

41216 (GSI–89-34(prepr.)) **The research program at SIS/ESR.** Henning, W. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Apr 1989. 17p. (CONF-8810261–: International workshop on nuclear dynamics at medium and high energies, Bad Honnef (Germany, F.R.), 10-14 Oct 1988). Order Number DE89795123/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A varied research program is currently in preparation for the expanded facility. Above one hundred experiments have been proposed following a call for proposals about 1 1/2 year ago, and have been reviewed by an international science committee. About half of the proposals were aimed at research in nuclear and nuclear-matter physics. These are discussed in more detail in the present overview. In addition, about 25% of the proposals were in the area of atomic physics, planning to make use of the capability of the new facility to strip even the heaviest ions into the innermost shells, with the additional possibility of subsequent cooling and deceleration. Biological research, utilizing the larger range of ions at elevated energies and thus deeper penetration and also irradiation in atmosphere, represented about 15% of the proposals; the rest was divided among various projects of applied research. (orig./HSI).

41217 (INP–1302/PS) **Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.** Broda, R.; Stachura, Z.; Styczen, J. (eds.). Institute of Nuclear Physics, Cracow (Poland). 1985. 442p. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

A report of recent experiments performed in different laboratories and a review of fundamental problems of nuclear physics connected with study of nuclear structure, that had just been solved are presented. The proceedings contain 33 articles. (M.F.-W.).

41218 (IPNO-DRE–88-36) **Nuclear physics.** Valentin, L. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 28p. (In French). Order Number DE89903308/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The shape and binding energy of nuclei are described and the main collision mechanisms at the origin of nuclear reactions induced by particles and heavy ions are presented. Typical applications of nuclear physics are quoted.

41219 (ISN–88-102) **Study of electric isovector giant nuclear resonances by the charge exchange reaction. Search for a monopole mode.** Berat, C. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 132p. (In French). Order Number DE89903292/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Charge exchange reactions (^{13}C, ^{13}N) and (^{13}C, ^{13}B) at 50 MeV/n are studied with the purpose of investigating the electric isovector modes of giant nuclear resonances in ^{12}C, ^{40}Ca, ^{58}Ni, ^{60}Ni, ^{90}Zr, ^{120}Sn and ^{208}Pb, and especially the monopole mode. Measurements have been performed at GANIL, using the magnetic spectrometer SPEG. The main characteristics of giant nuclear resonances are reviewed, and the ability of the chosen reactions to excite electric isovector modes is examined. Experimental setup and data reduction are described. Results are commented and analyzed. The analog state of the dipole resonance is strongly excited in nuclei with $A \leq 60$; excitation energies and widths are obtained with a good accuracy. For nuclei with $A \geq 60$, a large peak is observed in the spectra. Its excitation energy is closed to the excitation energy of the giant isovector monopole resonance, measured with the (π^-, π^0) reaction, except in ^{208}Pb. Experimental angular distributions do not quite show the features expected from DWBA calculations. The low-lying states of ^{12}N and ^{12}B are used to test the calculations and the reaction mechanisms.

41220 (ORNL/FTR–3323) **[International conference on the spectroscopy of heavy nuclei, Aghia Pelaghia, Crete (Greece) and visit to Giessen, West Germany, June 25–July 4, 1989]: Foreign trip report.** Beene, J.R. Oak Ridge National Lab., TN (USA). 12 Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015832/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the International Conference on the Spectroscopy of Heavy Nuclei at Aghia Pelaghia, Crete (Greece), and presented an invited talk entitled "Studies of Giant Resonances with Intermediate Energy Heavy Ions." After the conference the traveler visited the University of Giessen at Giessen, West Germany, for discussions with Volker Metag and members of the TAPS (Two Arm Photon Spectrometer) collaboration on future collaborative work and progress on the ORNL and TAPS BaF_2 arrays.

41221 (UCID–21694) **Program BREMS: A code designed to create a bremsstrahlung data base in the ENDL format.** Cullen, D.E.; Perkins, S.T. Lawrence Livermore National Lab., CA (USA). 14 Jul 1989. 39p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013972/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The computer code BREMS starts from the latest bremsstrahlung data of S.M. Seltzer and M.J. Berger (NBS) which is given in tabular form over the electron energy range 1 KeV to 10 GeV for elements with Z = 1 to 100. This data is extended to the energy range 10 eV to 100 GeV and converted to an accurately interpolable form in the ENDL format, which can be more easily used in applications. 3 refs.

6511 Experimental Techniques

41222 (GANIL-P–88-07) **Formation and decay of hot nuclei.** Galin, J. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 21p. (CONF-8806117–: 3. international conference on nucleus nucleus collisions, Saint-Malo (France), 6-11 Jun 1988). Order Number DE89903159/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The challenge in understanding the behaviour of hot nuclei is twofold: how are they formed in nucleus-nucleus collisions and how do they decay. Both aspects are considered in the light of theories developed recently and experimental data. Special emphasis has been put on the relevance of temperature measurements as well as on the concept of a limiting temperature.

41223 (PCCF-T–8801) **Experimental study of differential cross sections for e^+ e^- production pair near threshold with streamer chamber. Application for simulated calculations of electromagnetic showers.** Meunier, H. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. Jan 1988. 148p. (In French). Order Number DE89903169/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

This work, on electron pair production, is in three parts. Measure of energetic and angular distributions for baryum and uranium at 1.33 MeV. The results on the baryum are in good agreement with the exact calculations and show that the influence of screening effects is important on uranium. The measure was made with a streamer chamber associated with magnetic field and stereoscopic taking of photographs. Analytic continuation of electron pair production to the tip of the positon spectrum in point-Coulomb calculation. At high energy the value of this point is not zero. Determination of a

set of parameters in order to input the exact cross sections in electron gamma showers calculation above 5 MeV for lead.

41224 (PCCF-T–8804) **Proton-proton correlations study at small relative momentum in Ne + nuclei collisions with Diogene detector.** Dupieux, P. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. Feb 1988. 120p. (In French). Order Number DE89903160/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The study of proton-proton correlations at small relative momentum allows to measure the size and the density of the nuclear fireball. The method is applied to collisions of Ne (400 and 800 A.MeV) on various targets. In the first two chapters, we present some aspects of relativistic heavy ion collisions and a short description of the 4 π Diogene facility. Interferometry results are compared to the theoretical Koonin curves in order to extract the size of the source; a study of the distortions of these curves by the experimental biases has shown the important effects of the relative momentum resolution and double -track resolution. The results agree with the participant-spectator concept. The extracted values of the density are about 20% normal nuclear density, which shows that the method gives information on the final stage of the interaction. However, for light targets, densities are found two times higher for the 800 A. MeV experiments than for the 400 A.MeV ones; it can be interpreted as a greater compression in the first stage of the collision at 800 A.MeV. Non negligible lifetime of the source can modify some of these results. Finally, we show that the reaction plane effects, considered as a dynamical correlation, does not modify appreciably the interferometry patterns. In the conclusion, we give the optimal conditions to realize interferometry measurements in the future experiments.

6513 Nuclear Properties and Reactions, A=6-19, Experimental

Refer also to citation(s) 41148

41225 (CRN-PN–88-23) **New results on resonances in reactions involving C and N nuclei.** Haas, F. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France). 1988. 10p. (CONF-880766–: 5. international conference on clustering aspects in nuclear and subnuclear systems, Kyoto (Japan), 25-29 Jul 1988). Order Number DE89903161/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Recent experimental results on resonance phenomena in the ^{12}C + ^{12}C reaction and in ^{15}N and ^{14}C induced reactions are presented. In ^{12}C + ^{12}C, resonances are observed up to energies between E_{CM} = 35 and 45 MeV. At higher energies, interference phenomena dominate the interaction at large angles. Strong resonances are observed in ^{15}N and ^{14}C induced reactions where the number of open channels is small at energies well above the barrier.

41226 (INIS-SU–98, pp. 147) **Excitation function measurement of α-particle elastic scattering by ^{12}C, ^{14}N nuclei using nuclear recoil method.** Belyanin, O.P.; Sulema, V.N.; Chernov, I.P.; Cherdantsev, Yu.P.; Shadrin, V.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

HELIUM 4 TARGET/carbon 12 reactions; HELIUM 4 TARGET/nitrogen 14 reactions; ALPHA PARTICLES; CARBON 12; ELASTIC SCATTERING; EXCITATION FUNCTIONS; MEV RANGE 01-10; MEV RANGE 10-100; NITROGEN 14; RECOILS

41227 (JAERI-M–89-046) **Evaluation of neutron nuclear data of B-11.** Fukahori, Tokio. Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment. Apr 1989. 50p. (NEANDC(J)–135/U;INDC(JPN)–122/L). Order Number DE89014339/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI.

Nuclear data of B-11 have been evaluated in the energy range from 0.01 MeV to 20 MeV. The evaluated quantities are cross sections, angular distributions and energy spectra of secondary neutrons, and γ-ray data. The evaluation was performed by using the R-matrix theory below 7 MeV and multistep statistical model above 7 MeV. Below 7 MeV, R-matrix parameters of Koehler et al. were modified to fit experimental data of the total cross section. For calculation of the multistep statistical model, the optical model and the level density parameters were chosen to reproduce experimental data of charged particle emission and elastic scattering cross sections. Direct inelastic scattering processes for seven excited levels were considered with DWBA calculation. The results of present work are in good agreement with the experimental data of cross sections, angular distributions of secondary neutrons and double differential cross sections. They were compiled for JENDL-3 in the ENDF/B-V format.

6514 Nuclear Properties and Reactions, A=20-38, Experimental

Refer also to citation(s) 41079

41228 (IFUSP-P–761) **Structures in the excitation function of ^{24}Mg (^{16}O, ^{20}Ne)^{20}Ne and a non resonant description of these structures.** Lepine-Szily, A.; Lichtenthaler Filho, R.; Obuti, M.M.; Oliveira Junior, J.M. de; Portezan Filho, O.; Sciani, W.; Villari, A.C.C. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Dec 1988. 19p. Order Number DE89632411/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The excitation functions of the reactions $^{24}Mg(^{16}O,^{20}Ne)^{20}Ne$ and $^{24}Mg(^{16}O,\ ^{12}C)^{28}Si$ were measured at Θ_{CM}-90^0 and 70^0 respectively, in the energy interval of 25 MeV to 34 MeV in steps of 240 KeV. They display strong structures with widths of 1 to 2 MeV and are compared to calculations including the coupling to higher orders between elastic and α-transfer channels, through the dynamic α-transfer polarization potential. (author).

6515 Nuclear Properties and Reactions, A=39-58, Experimental

Refer also to citation(s) 41148

41229 (IPNO-T–89-04) **Giant resonances and high excitation energy structures excited by inelastic scattering of argon ions on zirconium and lead targets at 44 and 41 MeV/nucleon incident energy.** Beaumel, D. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 139p. (In French). Order Number DE89903286/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Giant resonance type collective modes excited in the reactions Ar40 + Zr90 and Ar40 + Pb208 were studied. A detailed analysis of the force distribution of the different multipolarities contributing to the low excitation energy region (10-15 MeV) is discussed. At higher energies (50 MeV) in inelastic spectra, relatively narrow structures are observed against a continuous background. Since these structures are at the same excitation energy in the inelastic path studied at two incident energies, it is concluded that they are not due to a three-body process but to excitation of the target. A theoretical analysis based on a multiphonon interpretation explains a large number of observations linked to these structures. An extension of the model is presented to justify this phenomenological model and to calculate the deviation of the real spectrum from a harmonic spectrum (anharmonicity).

41230 (JINR-E–1-88-244) **Nuclear reactions of medium and heavy target nuclei with high-energy projectiles. Spallation of ^{55}Mn, ^{59}Co, ^{nat}Ni and ^{nat}Cu by 3.65 A GeV ^{12}C-ions and 3.65 GeV protons.** Kozma, P.; Tumendemberel, B.; Chultem, D. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 18p. Order Number DE89632416/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Czech. J. Phys.

Nuclear reactions induced by 3.65 A GeV ^{12}C-ions and 3.65 GeV protons on target nuclei ^{55}Mn, ^{59}Co, ^{nat}Ni and ^{nat}Cu were investigated by using the foil stack activation technique and Ge(Li)

gamma-ray spectroscopy. Charge dispersions and mass-yield distributions of radioactive residues were obtained from the parametrization of measured spallation cross sections. The discussion of results from this and other radiochemical experiments with high-energy protons and ^{12}C ions with complex nuclei is presented in terms of the concepts of limiting fragmentation and factorization. 15 refs.; 3 figs.; 6 tabs.; submitted to the journal Czech. J. Phys.

41231 (LPCC-T–88-01) **Evolution of fusion for the systems $Ar^{40}+Ag^{108}$ and $Ar^{40}+Au^{197}$ between 39 and 60 MeV/A.** Eudes, P. Caen Univ., 14 (France). 1988. 105p. (In French). Order Number DE89903301/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

In this experiment performed at GANIL, the study of the reactions mechanisms which appear in the interaction Kr+Au at 35 and 44 MeV/u, is based on the correlations analysis between the heavy fragments produced. The use of the first available modulus of XYZT and DELF multidetectors allowed the observation of a significant population of three fold coincidence events (one forward fragment in XYZT (3^0, 30^0) and two fragments in DELF ($\pm 45^0$, $\pm 110^0$)). The velocity characteristics of the forward fragment enable one to separate two classes of events: First, coincidences between a projectile residue detected in XYZT and two target fragments in DELF. For these events, a study of incomplete linear momentum transfer leads to a transfer rate smaller than 20%. The different kinetic observables are then correctly reproduced by an abrasion-ablation model. Then, coincidences between three fragments that appear to come from only one source. The fragment's characteristics are compatible with a cracking mechanism of the target. The reaction mechanisms observed do not seem to be directly dependent on the projectile velocity but rather on the projectile energy.

6516 Nuclear Properties and Reactions, A=59-89, Experimental

Refer also to citation(s) 41229, 41230, 41231

41232 (CRN-PN–88-33) **Investigation of octupole deformations in the Fr^{217} nucleus by yrast spectroscopy.** Hulne, S. Strasbourg-1 Univ., 67 (France). 1988. 141p. (In French). Order Number DE89903310/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The spectroscopic characteristics of the yrast levels of Fr217 are determined. The level scheme up to a value of J = (39/2$^+$) for angular momentum and parity is established. The production of the Fr217 nucleus in a heavy ion collision reaction was only possible by using a radioactive Pb210 target. The method for preparing the target is described. The Fr217 nucleus belongs to the category of nuclei showing octupole effects. Mass A = 217 seems to be the lower limit of the region where these effects occur.

41233 (IPNO-T–89-02) **Investigation of dissipative transfer for energies from 8 to 40 MeV/A.** Tassan-Got, L. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Paris-11 Univ., 91 - Orsay (France). 1988. 218p. (In French). Order Number DE89903221/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

In order to have a deeper insight on some features of heavy ion deep inelastic reactions, an experimental study of the fragment yield in the ^{40}Ar + ^{197}Au and ^{40}Ca + ^{208}Pb systems, respectively at two incident energies, has been performed. The elaboration of a model based on stochastic transfers allowed to understand the drift on the mean values of measured distributions. It especially shows that the binary structure of the composite system survives as far as the energy dissipation is not too close to the maximal one. This constatation, associated to the direct results of the simulation, infers that the relaxation of the isospin mode is more likely to be carried by stochastic transfers than collective modes of the composite system. The implemented model has been applied to collisions at higher bombarding energy: near the Fermi energy. The comparison concerned energy spectra, moment dispersions, isotopic distributions, projectile-like target-like correlations, neutron multiplicities. This analysis allowed to reconcile experimental findings like high fragment velocities, excitation energy, and the drop of the yield for fragment masses higher than the projectile one. In spite of departures on the position of energy spectra and isotopic distributions, indicating the necessity for modifying the transfer mechanism or calling upon fragmentation, the overall good agreement shows that dissipative transfers are still playing a relevant role in this energy domain.

41234 (ISN–88-81) **Role of nucleon-nucleon collisions in peripheral nuclear reactions near 30 MeV/A. Study of neutrons/projectile-like fragment correlations in the ^{20}Ne + ^{165}Ho reaction at 30 MeV/A.** Alarja, J. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 149p. (In French). Order Number DE89903294/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Correlations between projectile-like fragments ($4 \leq Z < 10$) and neutrons produced in the ^{20}Ne + ^{165}Ho reaction at 30 MeV/A have been measured. Projectile-like fragments emitted at $\pm$ 8^0 were detected with two silicon detectors. Coincident neutrons were detected with 10 NE213 scintillators set between -140^0 and +140^0. Projectile-like fragment energy spectra and neutron velocity and multiplicity distributions were thus obtained. As a function of the charge and energy of the projectile-like fragment, neutron velocity spectra were analysed using three moving sources: a projectile-like source, a target-like source and an intermediate velocity source. Experimental results were compared with predictions of a statistical model, based on nucleon-nucleon collisions (code PERCUT), the de-excitation of primary products being treated by statistical evaporation models (codes LANCELOT and EVAP). For low linear momentum transfer collisions, experimental results are in good agreement with theoretical predictions.

6517 Nuclear Properties and Reactions, A=90-149, Experimental

41235 (GSI–89-48(prepr.)) **Low-lying levels in ^{104}In and a problem of spin-mixing in hyperfine fields.** Szerypo, J.; Barden, R.; Kirchner, R.; Klepper, O.; Roeckl, E.; Schardt, D.; Kalinowski, L.; Plochocki, A.; Rykaczewski, K.; Zylicz, J. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 21p. Order Number DE89795129/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The 16-s ^{104m}In and 21-s ^{104}Sn activities were produced at GSI in the ^{58}Ni+^{50}Cr reaction. On-line chemical- and mass-separation was applied to prepare samples of these activities for accurate γ-ray and conversion-electron spectroscopy. The energy difference ΔE = 290$\pm$20 eV and the spin difference ΔI=2 between the 93.5 keV isomeric and 93.2 keV short-lived levels of ^{104}In were established. Tentative spin/parity assignments are 3$^+$ for the 93.5 keV and 5$^+$ for the 93.2 keV state. An estimate is given for the amount of mixing of these two states if they are exposed to a gradient of a hyperfine electric field. The chance of detecting such mixing via its influence upon the half-life of the isomeric state is discussed. For comparison, the discussion includes also the mixing that would occur in the case of a magnetic field if the spin difference were ΔI=1. (orig.).

41236 (KIYI–88-13) **Study on cross sections of isomer population of ^{111m}Hg and ^{199m}Cd at inelastic scattering of photons at 4-10 MeV energies.** Bigan, Z.M.; Mazur, V.M.; Sokolyuk, I.V.; Sychev, S.I. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. 13p. (In Russian). Order Number DE89632428/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The cross sections of the (γ,γ') reaction are determined with excitation of isomeric states on nuclei of ^{111}Cd and ^{199}Hg. The measurements were made at 4-10 MeV energies. Results are compared with theoretical calculations by statistical Fermi-gas theory. 18 refs.; 3 figs.

6518 Nuclear Properties and Reactions, A=150-189, Experimental

41237 (INIS-SU–78, pp. 214-219) **Investigation of the neutron resonances of $^{155,157}Gd$ and ^{163}Dy nuclei over cascades**

from (n,γ) reaction. Efimov, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Muradyan, G.V.; Prokof'eva, L.Yu.; Belyaev, F.N.; Bolotskij, V.P.; Breslavskij, O.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; NITS.

Using the multiplicity spectrometry method, gamma-cascade from neutron resonances of ^{153,157}Gd and ^{163}Dy are invesigated. 134 new values of resonance spins of these nuclei are determined. Average distances and strength functions for resonances with different spins are obtained. 8 refs.; 3 figs.; 1 tab.

6519 Nuclear Properties and Reactions, A=190-219, Experimental

Refer also to citation(s) 41236, 41238

6520 Nuclear Properties and Reactions, A=220 and Above, Experimental

41238 (GSI–89-47(prepr.)) **Heavy element production and limits to fusion.** Muenzenberg, G. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 20p. (CONF-890491–: International conference on fifty years of research in nuclear fission, Berlin (Germany, F.R.), 3-7 Apr 1989). Order Number DE89795131/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The recent experiments on the synthesis of the heaviest elements led to the discovery of a region of nuclei of an unexpected high ground-state stability. The experimental results on our synthesis of new elements will be discussed as well as our new insights as their ground-state properties. The prospects to proceed to new elements will be outlined. (orig.).

6530 Nuclear Theory

Refer also to citation(s) 41178, 41180, 41192, 41217

41239 (CONF-8906168–2) **Understanding nuclear quadrupole deformations.** Raman, S. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on selected topics in nuclear structure; Dubna (USSR); 20-24 Jun 1989. Order Number DE89014089/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A simple ansatz that "Nuclei, not too near closed shells, are as deformed as they can be within a single major shell" appears to quantitatively reproduce the variations of the quadrupole moments and hence the deformations of nuclei. 6 refs., 3 figs.

41240 (ENEA-RT-TIB–88-17, pp. 1-7) **Shell model approach to the radial coupling form in the Direct-Semidirect model of nucleon radiative capture.** Guidotti, R. (Istituto Nazionale di Fisica Nucleare, Bologna (Italy)); Saporetti, F. ENEA, Rome (Italy). 1988. In *Contributions to perspectives on theoretical nuclear physics-2.* Order Number DE89012193/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The present work is devoted to a comparison shell-model and phenomenologic approaches to the particle-vibration coupling in the direct-semidirect model of radiative capture of fast nucleons and their effect on the evaluation of measurable quantities, such as cross sections at a given emission angle, NU=90 degrees.

41241 (ENEA-RT-TIB–88-17, pp. 8-19) **Fragmentation of the giant dipole resonance in an algebraic model.** Mino, G. (ENEA, Bologna (Italy)); Ventura, A.; Zuffi, L. ENEA, Rome (Italy). 1988. In *Contributions to perspectives on theoretical nuclear physics-2.* Order Number DE89012193/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A phenomenological algebraic approach to nuclear dipole excitations is presented within the framework of the interacting boson model. The application to photon absorption and scattering by nuclei in regions of shape transitions and axially symmetric deformations is discussed. Finally, an algebraic model for the coupling of giant dipole resonance states to fermion and isospin degrees of freedom is proposed and applied. 32 refs.

41242 (GSI–89-44(prepr.)) **Shock discontinuities around the confinement-deconfinement transition in baryon-rich dense matter.** Rischke, D.H.; Waldhauser, B.M.; Stoecker, H.; Greiner, W.; Friman, B.L. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 61p. Contract BMFT 06 0F 772;DFG Gr 243/32-2. Order Number DE89795124/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

We investigate shock discontinuities that involve a conversion of hadronic matter into quark-gluon matter and vice versa. Such discontinuities may develop when nuclear matter is compressed to energy densities beyond the deconfinement transition and in the hadronization of an expanding quark-gluon plasma. In these investigations we study the influence of various phenomenological equations of state. Consequences for entropy production in heavy-ion collisions are discussed and estimates of inclusive particle ratios at freeze-out are given. We find that antiparticle-to-particle ratios may be enhanced by an order of magnitude if a quark-gluon plasma is created during the collision compared to a purely hadronic collision scenario. (orig.).

41243 (IFUSP-P–737) **Three-body corrections to the inclusive break up cross section.** Frederico, T.; Mastroleo, R.C.; Hussein, M.S. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1988. 20p. Order Number DE89632312/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Three-body corrections to the DWBA inclusive break up cross section are derived and discussed. A new sum rule, similar in structure to the Ichimura, Austern and Vincent sum rule, but contains the full three-body corrections at the DWBA level, is derived and analyzed within a Glauber-type approximation. (author).

41244 (INIS-GB–193) **Manchester nuclear physics report. August 1987 - December 1988.** Manchester Univ. (UK). Simon Engineering Labs. 1989. 145p. Order Number DE89632250/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

This report describes the experimental research of the Manchester University Nuclear Physics Group for the period August 1987 - December 1988. The experiments have been performed at the Daresbury Nuclear Structure Facility, mostly using the gamma-ray arrays and the Recoil Separator. However, experiments using the Daresbury Isotope Separator, the Oxford Folded Tandem and the new charged particle detector array are also reported. Studies of gamma decaying states in ^{21}Ne and ^{23}Na are reported. The spectroscopy of medium mass nuclei includes the investigation of the Gamow-Tellar decay of ^{96}Cd. Fourteen studies of the spectroscopy of nuclei with $A \geq 100$ are reported. Fission studies and instrumentation and computer developments are also included. (U.K.).

41245 (INIS-mf–11992) **Gross properties of nuclei and nuclear excitations. Proceedings.** Feldmeier, H. (ed.). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik. 1989. 284p. (CONF-890161–: 17. international workshop on gross properties of nuclei and nuclear excitations, Hirschegg (Austria), 15-19 Jan 1989). Order Number DE89795177/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

These proceedings contain the articles presented at the named workshop. These concern new developments in nuclear structure studies, relativistic heavy ion reactions, and advanced techniques for nuclear spectroscopy. (HSI).

41246 (INIS-SU–98, pp. 103) **Relativistic nuclear spectroscopy.** Vorob'ev, S.A.; Pivovarov, Yu.L.; Shirokov, A.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May -

1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

NUCLEI/channeling; COULOMB EXCITATION; CRYSTALS; NUCLEI; CHANNELING; RELATIVISTIC RANGE

41247 (IPNO-DRE–88-08) **Damping of high-lying single-particle modes in heavy nuclei.** Gales, S.; Stoyanov, C.; Vdovin, A.I. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 149p. Order Number DE89903220/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The recent experimental and theoretical results on the damping of high lying single-particle modes in heavy nuclei are reviewed. In one nucleon transfer reaction these states manifest themselves as broad 'resonance' like structures superimposed on a large continuum. The advantages and the limitations of the transfer reaction approach will be presented using the results from neutron and proton pick-up and stripping reactions. The problem raised by the subtraction of the underlying background, the assumptions made to describe the reaction process and the method used to extract the strength distributions are presented. The existing empirical systematics is summarized for nuclei ranging from ^{90}Zr to ^{208}Pb. The theoretical approaches used to explain the damping of the high-lying single-particle modes are based on the coupling between collective and single-particle degrees of freedom. The two steps of the damping mechanism are discussed in details within the framework of the quasiparticle phonon nuclear model. A large scale of comparison between the measured and calculated average energies, spreading widths and spectroscopic strengths of the high-lying single-particle (hole) states in heavy nuclei is presented. The systematic features of the damping (energy, angular momentum and isotopic dependence) are discussed. The detailed study of the damping mechanism of high -lying single-particle modes reveal new features and lead us to a new field in nuclear structure: 'the spectroscopy of inner and outer subshells'.

41248 (ISN–88-71) **Effects of two-nucleon collisions on nucleon state broadening and on the nuclear response function in the quasi-elastic peak region.** Jaenicke, J. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 209p. (In French). Order Number DE89903284/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The longitudinal charge function in the quasi-elastic peak region is calculated, including effects of two-nucleon collisions. The coupled RPA equation for 2p2h states is solved, using a Thomas-Fermi type theory. To calculate the response function for RPA orders, the Gogny force (a density dependent finite range force) is used, both for the mean field and the residual ph interaction. To include the 2p2h states it was necessary to study the dynamic nuclear mass operator M in the 2p1h (2h1p) approximation. The Gogny force was used as interaction at the vertex of the mass operator. The density dependence of the Gogny force gives a pronounced surface peak in the imaginary part of M. The inclusion of the mass operator in the ph motion gives 2p2h states. Their influence considerably reduces the RPA order response and generally produces a better agreement between theory and experiment, although inexplicable exceptions remain. The investigation suggests that it is not necessary to modify the nuclear form factor.

41249 (LBL–27322) **Mean field and collisions in hot nuclei.** Kumlt ohler, H.S. Lawrence Berkeley Lab., CA (USA). Jun 1989. 12p. Sponsored by DOE/ER;OGA. DOE Contract AC03-76SF00098. PHY86-04602. (CONF-8905143–4: NATO international advanced courses on the nuclear equation of state, Peniscola (Spain), 12 May - 3 jun 1989). Order Number DE89015227/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Collisions between heavy nuclei produce nuclear matter of high density and excitation. Brueckner methods are used to calculate the momentum and temperature dependent mean field for nucleons propagating through nuclear matter during these collisions. The mean field is complex and the imaginary part is related to the "two-body" collision, while the real part relates to "one-body" collisions. A potential model for the N-N interactions is avoided by calculating the Reaction matrix directly from the T-matrix (i.e., N-N phase shifts) using a version of Brueckner theory previously published by the author. Results are presented for nuclear matter at normal and twice normal density and for temperatures up to 50 MeV. 23 refs., 7 figs.

41250 (Lund-MPh–88/4) **Transition operator for high-energy γ-rays.** Sahrling, M. Lund Univ. (Sweden). Dept. of Mathematical Physics. 10 Mar 1988. 63p. Order Number DE89795245/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The thesis consists of three chapters and some appendices. In the first chapter the usual quantization, using so called multipole fields, is described. The second chapter describes the analytical calculations with and without the spin interaction. Section II:1 contains a recapitulation of the long-wavelength approximation while exact expressions for transition speeds are given in section II:2. Selection rules are discussed in section II:3. Chapter three, finally, describes and explains the numerical calculations. Generally, the calculations have been performed for single-particle transitions utilizing harmonic oscillator wave-functions. Only electrical dipole and quadrupole transitions are considered. (orig./HSI).

41251 (ORNL/FTR–3321) **[International conference on selected topics in nuclear structure, Dubna, USSR and visits to Kiev and Gatchina, USSR, June 19–30, 1989]: Foreign trip report.** Raman, S. Oak Ridge National Lab., TN (USA). 17 Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015089/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the International Conference on Selected Topics in Nuclear Structure (Dubna, USSR, June 20–24, 1989), where he presented an invited talk. This report gives some highlights of this conference. Following the conference, he visited the Institute of Nuclear Research, Kiev, USSR, and the Leningrad Nuclear Physics Institute, Gatchina, USSR. This report also gives his impressions of these visits.

41252 (UFPB-DF–01/89) **Structure of ^{88}Kr nuclei within the cluster phonon coupling model.** Losano, L.; Dias, H. Paraiba Univ., Joao Pessoa, PB (Brazil). Dept. de Fisica. 1989. 14p. Order Number DE89632275/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The description of the low energy spectra of ^{88}Kr is performed in terms of the model in which two neutrons are coupled to the quadrupole vibrational field. The residual interaction among the valence neutrons is aproximated by the pairing force. Excitation energies and B(E2) values are calculated and compared with the corresponding experimental data. Our results are also compared with those obtained using the interacting boson approximation (IBA-2 MODEL). (author).

41253 Electro- and photonuclear physics with polarized beams and targets. Holt, R.J. (Physics Div., Argonne National Lab., Argonne, IL (US)). vp. of Modern developments in nuclear physics. Sushkov, O.P. World Scientific Pub. Co., Teaneck, NJ (1988). (CONF-8706232–: International symposium on modern developments in nuclear physics, Novosibirsk (USSR), 27 Jun - 1 jul 1987).

Two long-standing issues in photonuclear physics, the giant M1 resonance in the Pb nucleus and deuteron photodisintegration, have been studied recently with polarized photons at Urbana and Frascati, respectively. The implications that this work has for settling these key issues are discussed. In addition, the advantages of the internal polarized target method for electron scattering studies are discussed and the technology of internal polarized target development is reviewed. The first results from a spin-exchange, optically-pumped polarized H and D source are presented.

41254 Prospects of nuclear physics with electromagnetic probes. Kowalski, S. (Bates Linear Accelerator Center Lab. for Nuclear Science and Dept. of Physics, Massachusetts Institute of Technology, Cambridge, MA (US)). vp. of Modern developments in nuclear physics. Sushkov, O.P. World Scientific Pub. Co., Teaneck, NJ (1988). (CONF-8706232–: International symposium on modern developments in nuclear physics, Novosibirsk (USSR), 27 Jun - 1 jul 1987).

The authors review some of the recent results in the use of electromagnetic probes to study nuclei. They also point to new directions - particularly those emphasizing spin observables - which

promise to keep the field vital, productive and exciting in the future. The electromagnetic interaction is a very important probe of nucleon and nuclear structure and dynamics. Systematic precise determination of nuclear charge and magnetic distributions, probing in momentum space the wave function of valence nucleons, stringent tests of nuclear mean field theory which is basic to the understanding of nuclear structure and dynamics, testing the validity of a deformed intrinsic state for describing the spectroscopy of rigid rotators, probing the momentum distribution of nucleons in nuclei to understand their identity in the medium, demonstration of scaling in deep inelastic electron-proton scattering (discovery of quark); are examples of some of the important recent investigations which have had significant impact on the field.

6540 Radiation and Shielding Physics

Refer also to citation(s) 40230, 41332

41255 (CONF-890408–15) **A parallel approach to the nodal method solution of the two-dimensional diffusion equation.** Kirk, B.L.; Azmy, Y.Y. Oak Ridge National Lab., TN (USA). 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM (USA); 9-13 Apr 1989. Order Number DE89015901/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The neutron diffusion equation in two-dimensional geometry is solved using the nodal method formalism. Three systems of equations arise in the solution: the x-current continuity equations, the y-current continuity equations and the balance of neutrons equations. An iterative procedure is developed to solve for the surface fluxes and cell-averaged fluxes by de-coupling the set of balance equations from the two current continuity systems. The iteration is initiated in the balance equation which supplies the starting estimates of the cell-averaged fluxes. These estimates are fed into the uncoupled, tridiagonal sets of x-current and y-current equations which can be solved independently of each other, so that the surface fluxes can be computed. The resulting surface fluxes are substituted into the balance equations to update the cell-averaged fluxes. These updated values become the new iterates. The independent nature of the x- and y-current continuity equations becomes the focal point of parallelism. The algorithm is implemented on two types of parallel machines – the INTEL iPSC/2 hypercube which belongs to the class of distributed memory processors and the Sequent balance 8000 which is a shared memory computer. Results indicate the algorithm to be better suited for a shared memory environment. 10 refs., 1 fig., 2 tabs.

41256 (FEI–1902) **Algorithm for the solution of the P_1-equation for the complex program of calculating radiation protection.** Kurachenko, Yu.A.; Ginkin, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 16p. (In Russian). Order Number DE89632245/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Algorithm of operative solution of the P_1-equation system of the method of spherical harmonics for cylindrical two-dimensial shield compositions has been developed and realized in the program. The algorithm is intended to be included into the system of program complex shield calculation according to techniques, combining succession application of discrete ordinate method and P_1-approximation. The algorithm is oriented to solution of the problems with preliminary axial radiation propagation at rather small gradients of solution with respect to radial variable. Difference analogues of P_1-equations were obtained under the assumption of exponential solution dependence on axial variable. The system of nonlinear finite-difference equations is solved with the use of effective technique, lying in successive application of h-factorization and parabolic runs. Independent algorithm testing, which demonstrated quick convergency of calculation process for a wide range of model problems, was conducted. 9 refs.; 3 figs.

41257 (ISN–88-70) **Double charm baryons and other aspects of hadron spectroscopy.** Fleck, S. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 133p. (In French). Order Number DE89903219/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

This theory deals mainly with hadron spectroscopy, which is tackled by two different means: non relativistic potential models and adiabatic bag models. The first approach involves the solution of a three-body problem, which is achieved using the formalism of hyperspherical harmonics. A systematic study of the diquark structure in baryons concludes this part of the work. Bag models are reviewed and used to study the possible binding of multiquark states containing five or six quarks. Finally, a systematic study of baryons with double charm is presented.

41258 (RAL–89-024) **Experimental techniques and resolution effects in deep inelastic neutron scattering at ISIS.** Holt, R.S. Rutherford Appleton Lab., Chilton (UK). Apr 1989. 26p. Order Number DE89632247/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A brief review is given of the experimental techniques currently employed on the pulsed neutron source, ISIS, at the Rutherford Appleton Laboratory to determine atomic momentum distributions by Deep Inelastic Neutron Scattering (DINS). Particular attention is given to the components of the instrument resolutions in energy and momentum space. Future developments of DINS using high energy chopper spectrometers and neutron resonance absorption techniques are discussed. (U.K.).

41259 (WAPD-TM–1628) **Taylor parameters for gamma-ray buildup factors in the proposed American National Standard.** Shure, K.; Wallace, O.J. Bettis Atomic Power Lab., West Mifflin, PA (USA). Oct 1988. 111p. Sponsored by U.S. DOE Energy Research. DOE Contract AC11-89PN38014. Order Number DE89014418/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Parameters have been determined for the Taylor two-exponential representation of the gamma-ray dose and energy absorption buildup factors contained in a proposed American National Standard on gamma-ray attenuation. These buildup factors are for 26 materials, 25 source energies, and 16 depths of penetration up to 40 mean-free-paths. 5 refs., 30 tabs.

6550 Medical Physics

Refer also to citation(s) 40059, 40790, 40807, 40963, 40964, 41259

41260 (INIS-mf–11460, pp. 325-343) **Radiation dosimetry.** Aymar A, J. (Nuclear Control S.A., Lima (Peru)); Medina G, H. Instituto Peruano de Energia Nuclear, Lima (Peru); Sociedad Peruana de Ensayos No Destructivos (SPEND), Lima (Peru). Sep 1988. (In Spanish). (CONF-8809372–: 2. Congress on NDT for Latin America and the Caribbean, Lima (Peru), 25-28 Sep 1988). In *2. Congress on NDT for Latin America and the Caribbean.* Order Number DE89012188/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Film is one of the most simple ways to detect radiation although for film as dosimeters a careful attention is required in many aspects, such as emulsion characteristics, film response capacity processing techniques and interpretation of the exposition. Surpassing these factors the film dosimeter is the most reliable.

41261 (INIS-mf–11502, pp. 21-22) **Radon issue. Review.** Schlesinger, T. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Margaliot, M. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

41262 (INIS-mf–11502, pp. 40-41) **Occupational exposures in Israel in 1987.** Malchi, S. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Shamai, Y.; Schlesinger, T.; Israeli, M. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

41263 (INIS-mf–11502, pp. 85) **Reevaluation of nationwide trend in X-Ray exposure of medical patients.** Ne'eman, E.; Lichter, A. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

41264 (NRPB-R–191) **Gamma-radiation levels outdoors in Great Britain.** Green, B.M.R.; Lomas, P.R.; Bradley, E.J.; Wrixon, A.D. National Radiological Protection Board, Chilton (UK). Feb 1989. 39p. Available from H.M. Stationery Office, London, price Pound 5.00.

Terrestrial gamma-ray dose rates have been measured out-of-doors throughout Great Britain. The results are presented in tabular, graphical and cartographical form and related to the nature of the ground and other influences. The mean absorbed dose rate out-of-doors is 34 nGy h^{-1} in air. The annual effective dose equivalent, when the duration of outdoor exposure and the distribution of the population are considered, is about 16 μSv on average. This dose is in addition to those doses received from gamma-rays indoors and from other sources of natural radiation. The information presented here facilitates the interpretation of monitoring results for artificial radioactivity in the environment. (author).

6560 Condensed Matter Physics

Refer also to citation(s) 40443, 40553, 41055, 41071

41265 (CONF-890821–1) **The temporal development of collision cascades in the binary collision approximation.** Robinson, M.T. Oak Ridge National Lab., TN (USA). Jul 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international conference on atomic collisions in solids; Aarhus (Denmark); 7-11 Aug 1989. Order Number DE89015860/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A modified binary collision approximation (BCA) was developed to allow explicit evaluation of the times at which projectiles in a collision cascade reach significant points in their trajectories, without altering the "event-driven" character of the model. The modified BCA was used to study the temporal development of cascades in copper and gold, initiated by primary atoms of up to 10 keV initial kinetic energy. Cascades generated with time-ordered collisions show fewer "distant" Frenkel pairs than do cascades generated with velocity-ordered collisions. In the former, the slower projectiles tend to move in less-damaged crystal than they do in the latter. The effect is larger in Au than in Cu and increases with primary energy. As an approach to cascade nonlinearities, cascades were generated in which stopped cascade atoms were allowed to be redisplaced in later encounters. There were many more redisplacements in time-ordered cascades than in velocity-ordered ones. Because of the additional stopping introduced by the redisplacement events, the cascades in which they were allowed had fewer defects than occurred otherwise. This effect also was larger in Au than in Cu and larger at high energies although most of the redisplacement encounters involved only low-energy particles. 13 refs., 5 figs., 4 tabs.

41266 (EUR–11752) **Sink strengths of dislocations taking into account bulk recombination effects.** Steinback, E. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 36p. (In German). Available from NTIS (US Sales Only), PC A03/MF A01.

The applicability of the rate theory to describe radiation damage processes is closely associated with the calculation of the various sink strengths. In this connection the effect of bulk recombination is usually neglected, because of the complexity of the problem. For this reason we present in this paper, for the first time, by means of the rigorous elastic-field model of a dislocation embedded in a lossy continuum, analytic expressions for the diffusion flux of irradiation-induced point defects into a dislocation, taking into account the elastic interaction, additional sinks and higher order bulk recombination effects. The resulting self-consistent formulae for the dislocation sink strengths clearly demonstrate the importance of the bulk recombination for the micro-structures of irradiated materials. In conjunction with the Harwell computer code VS5 it became clear that this new dislocation bias also leads to a change in the macrostructural observables. The order of magnitude of this effect emphasizes that neglecting bulk recombination as a general principle is not justified.

41267 (FEI–1892) **Increase of resolution in Moessbauer spectra.** Petrov, D.V.; Zakurkin, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 10p. (In Russian). Order Number DE89631824/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Consideration is being given to algorithm of the method for increasing resolution in Moessbauer spectra, based on mathematical body of restoration and improvement of image quality. Application of results of program for increase of resolution in model and experimental Moessbauer spectra are presented. 2 refs.; 2 figs.

41268 (INIS-BR–1556) **Study of particles in solution by small angle x-ray scattering.** Itri, R. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 134p. (In Portuguese). Order Number DE89631825/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The implantation of SAXS technique is presented, and mycellas in solution of the dodecyl sodium sulfate SLS/water system are studied. A synthesis of SAXS theory to study parameters such as, volume, radii of gyration and specific surface and distribution function of the distance of homogenous and inhomogeneous particles is also presented. The technique was implanted by the study of a vitreous coal sample with voids in amorphous matrix. Computer programs were used for data treatment. It was concluded that the void configuration must be an oblate ellipsoid with rippled external surface and radii of gyration of ~20A . The study of mycellas in solution of the SLL/H_2O binary system showed spherical mycellas with paraffinic radii of 16A and total radii of 25.5 A. Interaction effects start to appear in 15% SLS concentrations. The change in the scattering curve occurs due to the interactions between mycellas. The isotropic-nematic transition in the ternary system by decanol addition was also investigated. (M.C.K.).

41269 (INIS-mf–11501) **Investigation of the luminescence of organic systems under excitation in the ultra far vacuum ultraviolet radiation.** Loewinger, E. Hebrew Univ., Jerusalem (Israel). Feb 1981. 86p. (In Hebrew). Order Number DE89631929/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The absorption of high energy particles or photons in matter and subsequent release of secondary particles are exceedingly fast processes. These primary interactions lead to excited and ionized molecules and to a large number of low energy electrons with well defined distribution of their kinetic energies. These low energy electrons interact with the molecules of the medium in ways which are still poorly understood. We assumed that the evaluation of the relative importance of these processes would be gained by the study of the luminescence of certain systems when they are excited by photons of gradually increasing energy, starting from the optical region, where the behavior of the systems are relatively well known, up to the region of soft X-rays, thus closing the gap between optical and high energy excitation. Results are discussed in terms of energy transfer from the host to the guest molecules and it is shown that these processes are dependent on the excitation energy. From the results of this work it seems to follow, that whenever the excitation energy exceeds the first ionization potential, an increase in fluorescence yield with excitation energy, should be expected. The absence of such an increase, though frequently met, is due to competing processes which may differ from system to system. 95 refs.

41270 (INIS-SU–89, pp. 170-171) **NMR ^{7}Li and quadrupole effects in $Li_xV_2O_5$.** Zhuravlev, N.A. (AN SSSR, Sverdlovsk (USSR). Inst. Khimii); Dmitriev, A.V.; Lakhtin, A.A.; Novak, P.Ya.; Pletnev, R.N. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

LITHIUM COMPOUNDS/nuclear magnetic resonance; LITHIUM COMPOUNDS/transition temperature; VANADATES/nuclear magnetic resonance; VANADATES/transition temperature; CRYSTALS; LITHIUM 7; ORDER-DISORDER TRANSFORMATIONS; SPECTRA; TEMPERATURE DEPENDENCE; VANADATES; VANADIUM 51

41271 (INIS-SU–98) **Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.** AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. 174p. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Individual papers in these proceedings are indexed separately.

41272 (INIS-SU–98, pp. 85) **Incoherent scattering effect on the radiation spectrum of channeling particles.** Avakyan, A.R.; Arutyunyan, A.S.; Shi, Ya. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

CHANNELING/electromagnetic radiation; CHARGED PARTICLES/channeling; CHANNELING; CRYSTALS; EMISSION SPECTRA; INCIDENCE ANGLE; INCOHERENT SCATTERING

41273 (INIS-SU–98, pp. 86) **Channeled particle radiation in the ultrasonic wave field.** Vel'ko, A.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

POSITRON CHANNELING/electromagnetic radiation; POSITRON CHANNELING/ultrasonic waves; ANGULAR DISTRIBUTION; EMISSION SPECTRA; GHZ RANGE 100-1000; MONOCRYSTALS

41274 (INIS-SU–98, pp. 87) **Classical analogue of electron axial channeling in monocrystals.** Vel'ko, A.V.; Kalashnikov, N.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRON CHANNELING; ANGULAR DISTRIBUTION; ELECTROMAGNETIC RADIATION; INCIDENCE ANGLE; MAGNETIC FIELDS; MONOCRYSTALS; RELATIVISTIC RANGE; SPECTRAL DENSITY

41275 (INIS-SU–98, pp. 89) **Effects of detector and planar scattering on the radiation spectral shift and line broadening when electron planar channeling in a diamond.** Burenkov, A.F.; Dudchik, Yu.I.; Komarov, F.F. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

DIAMONDS/electron channeling; ANGULAR DISTRIBUTION; DIAMONDS; EMISSION SPECTRA; LINE BROADENING; MEV RANGE 10-100; RADIATION DETECTION; SCATTERING; SPECTRAL SHIFT

41276 (INIS-SU–98, pp. 90) **Simulation of radiation losses of axially channeled electrons.** Ignat'ev, S.V.; Muralev, V.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRON CHANNELING/energy losses; DIAMONDS; ELECTROMAGNETIC RADIATION; GERMANIUM; GEV RANGE 01-10; INCIDENCE ANGLE; MONOCRYSTALS; MULTIPLE SCATTERING; SILICON; THICKNESS; TUNGSTEN

41277 (INIS-SU–98, pp. 91) **Simulation of the angular distribution of electron axial channeling radiation.** Ignat'ev, S.V.; Muralev, V.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRON CHANNELING/gamma spectra; ANGULAR DISTRIBUTION; DIAMONDS; ENERGY LOSSES; GERMANIUM; GEV RANGE 01-10; MONOCRYSTALS; SILICON; THICKNESS; TUNGSTEN

41278 (INIS-SU–98, pp. 93) **Polarization of electron incoherent hard bremsstrahlung in a diamond crystal.** Ermak, V.P.; Zhebrovskij, Yu.V.; Kas'yan, S.V.; Noga, V.I.; Pegushin, E.V.; Rubashkin, A.A.; Sanin, V.M.; Semisalov, I.L. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

DIAMONDS/electrons; ANGULAR DISTRIBUTION; BREMSSTRAHLUNG; CRYSTALS; DIAMONDS; ELECTRONS; GAMMA RADIATION; INCIDENCE ANGLE; INCOHERENT SCATTERING; MEV RANGE 100-1000; POLARIZATION-ASYMMETRY RATIO; POLARIZED BEAMS

41279 (INIS-SU–98, pp. 94) **Orientation dependences of the hard incoherent bremsstrahlung yield from electrons moving near a crystal plane.** Zhebrovskij, Yu.V.; Pegushin, E.V.; Rubashkin, A.L.; Semisalov, I.L.; Sanin, V.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/electron channeling; ANGULAR DISTRIBUTION; BREMSSTRAHLUNG; GEV RANGE 01-10; INCIDENCE ANGLE; INCOHERENT SCATTERING; MONOCRYSTALS; PHOTOPRODUCTION; PIONS; POLARIZED BEAMS; SILICON

41280 (INIS-SU–98, pp. 95) **Parametric X radiation at small-angle interaction of relativistic electrons with a system of crystallographic planes.** Lapko, V.P.; Nasonov, N.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

CRYSTALS/electrons; ANGULAR DISTRIBUTION; BRAGG REFLECTION; COHERENT SCATTERING; CRYSTALS; ELECTRONS; RELATIVISTIC RANGE; SMALL ANGLE SCATTERING; X RADIATION; X-RAY SPECTRA

41281 (INIS-SU–98, pp. 95-96) **Relativistic electron coherent bremsstrahlung from very thick monocrystals.** Vnukov, I.E.; Kalinin, B.N.; Potylitsin, A.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

BREMSSTRAHLUNG/electron channeling; BREMSSTRAHLUNG; DIAMONDS; INCIDENCE ANGLE; MONOCRYSTALS; MULTIPLE SCATTERING; RELATIVISTIC RANGE; SILICON; THICKNESS; TUNGSTEN

41282 (INIS-SU–98, pp. 99) **Effective mass of channeling electrons.** Kaplin, V.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRON CHANNELING/effective mass; BINDING ENERGY; BRAGG REFLECTION; CRYSTALS; MEV RANGE 01-10

41283 (INIS-SU–98, pp. 92) **Characteristics of relativistic electron γ-radiation in silicon crystals.** Andreyashkin, M.Yu.; Vnukov, I.E.; Vorob'ev, S.A.; Zabaev, V.N.; Kalinin, B.N.; Naumenko, G.A.; Potylitsin, A.P.; Sarychev, V.P.; Yalova, L.E.; Amosov, K.Yu. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRONS/gamma spectra; SILICON/electrons; CRYSTALS; ELECTRONS; LOW TEMPERATURE; MEV RANGE 100-1000; ORIENTATION; SILICON; SPECTRAL SHIFT; TEMPERATURE DEPENDENCE; THICKNESS

41284 (INIS-SU–98, pp. 100) **Channeled electrons in the problem of visualization of point defects of a crystal lattice.** Vergasov, V.L.; Shkornyakov, S.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRON CHANNELING/point defects; CRYSTALS; KEV RANGE 100-1000; OCCUPATION NUMBER; SELECTION RULES; THICKNESS

41285 (INIS-SU–98, pp. 101) **Representation of the crystal structure and its possible identification via densely occupied electron states.** Vergasov, V.L. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRON CHANNELING/crystal structure; ELECTRON MICROSCOPY; ELECTRONIC STRUCTURE; ENERGY-LEVEL DENSITY; INCIDENCE ANGLE; INTERATOMIC DISTANCES; KEV RANGE 100-1000; SILICON

41286 (INIS-SU–98, pp. 102) **Monte-Carlo simulation of the spectrum of 150 GeV e^- energy losses in germanium.** Tikhomirov, V.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ELECTRONS/germanium; CRYSTALS; ELECTRONS; GERMANIUM; ENERGY LOSSES; GAMMA SPECTRA; GEV RANGE 100-1000; MONTE CARLO METHOD; MULTIPLE SCATTERING

41287 (INIS-SU–98, pp. 104) **Structure of hidden Si_3N_4 layers in silicon synthesized by highly intense nitrogen ion implantation.** Komarov, F.F.; Novikov, A.P.; Petrov, S.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; SILICON/silicon nitrides; KEV RANGE 100-1000; LAYERS; MONOCRYSTALS; NITROGEN IONS; POLYCRYSTALS; SILICON; TIME DEPENDENCE

41288 (INIS-SU–98, pp. 105) **Arsenic behaviour in silicon crystals under irradiation in the self-annealing implantation mode.** Komarov, F.F.; Novikov, A.P.; Podlipko, Yu.A.; Kotov, E.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; ANNEALING; ARSENIC IONS; CRYSTALS; KEV RANGE 100-1000; MEV RANGE 01-10; PHYSICAL RADIATION EFFECTS; RANGE; SILICON; TIME DEPENDENCE

41289 (INIS-SU–98, pp. 106) **Redistribution of nitrogen implanted into silicon at 700-1100 deg C.** Kachurin, G.A.; Tyshchenko, I.E.; Popov, V.P.; Tijs, S.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; SILICON/silicon nitrides; ANNEALING; CRYSTAL DEFECTS; HIGH TEMPERATURE; KEV RANGE 100-1000; MEV RANGE 01-10; NITROGEN IONS; RADIATION DOSES; RANGE; SILICON; TEMPERATURE DEPENDENCE; TIME DEPENDENCE; VERY HIGH TEMPERATURE

41290 (INIS-SU–98, pp. 108) **Boron implantation effect on the temperature stability of mixed atomic layers in the Zr/Ni system.** Gol'tsev, V.P.; Khodasevich, V.V.; Prikhod'ko, I.I.; Uglov, V.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

NICKEL/ion implantation; ZIRCONIUM/ion implantation; ANNEALING; ARGON IONS; FILMS; KEV RANGE 10-100; KEV RANGE 100-1000; NICKEL; NICKEL BORIDES; RADIATION DOSES; SUBSTRATES; VERY HIGH TEMPERATURE; ZIRCONIUM; ZIRCONIUM OXIDES

41291 (INIS-SU–98, pp. 112) **He ion Rutherford backscattering method applied to studying semiconductor laser-modified layers.** Kolosov, Yu.N.; Kulikauskas, V.S.; Nevolin, V.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

CHROMIUM/ion implantation; INDIUM COMPOUNDS/ion implantation; SELENIUM/ion implantation; SILICON/ion implantation; ANTIMONIDES; CHROMIUM; CRYSTAL DEFECTS; DIFFUSION; FILMS; HELIUM IONS; HETEROJUNCTIONS; HIGH TEMPERATURE; LAYERS; MONOCRYSTALS; P-N JUNCTIONS; RUTHERFORD SCATTERING; SELENIUM; SILICON; SUBSTRATES; TEMPERATURE DEPENDENCE; THICKNESS

41292 (INIS-SU–98, pp. 114) **Kinetics of recrystallization and of activation of an implanted impurity in ion-implanted silicon layers exposed to intense ion beams.** Troitskij, V.Yu.; Makukha, Yu.V.; Stoyanova, I.G.; Shestakov, A.V.; Gurova, G.A.; Nikiforova, V.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; SILICON/recrystallization; ANNEALING; ARGON IONS; BORON FLUORIDES; BORON IONS; HELIUM IONS; HIGH TEMPERATURE; ION BEAMS; PHOSPHORUS IONS; SILICON; RECRYSTALLIZATION; VERY HIGH TEMPERATURE

41293 (INIS-SU–98, pp. 115) **Structural modifications in implanted indium phosphide layers on fast thermal annealing.** Gajduk, P.I.; Komarov, F.F.; Sivitskij, A.G.; Solov'ev, V.S.; Tikavyj, I.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

INDIUM PHOSPHIDES/ion implantation; ANNEALING; DISLOCATIONS; HELIUM IONS; ION CHANNELING; KEV RANGE 100-1000; LAYERS; MEV RANGE 01-10; RADIATION DOSES; SILICON IONS; STACKING FAULTS; TWINNING; VERY HIGH TEMPERATURE

41294 (INIS-SU–98, pp. 117) **Energy redistribution and temperature establishment in the range of linear collisional cascades.** Lobanok, V.G.; Komarov, F.F.; Novikov, A.P.; Urbanovich, A.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/lte; SILICON/physical radiation effects; DISPLACEMENT RATES; CASCADE THEORY; CRYSTALS; ION BEAMS; SILICON; LTE

41295 (INIS-SU–98, pp. 118) **Mo/Si system mixing by highly intense ion beams.** Gushchinskij, S.A.; Novikov, A.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

MOLYBDENUM/physical radiation effects; SILICON/physical radiation effects; ANNEALING; CRYSTAL DEFECTS; CRYSTAL-PHASE TRANSFORMATIONS; HIGH TEMPERATURE; ION IMPLANTATION; KEV RANGE 100-1000; LAYERS; MILLI AMP BEAM CURRENTS; MIXING; MOLYBDENUM; MOLYBDENUM SILICIDES; NITROGEN IONS; POLYCRYSTALS; SILICON; SPUTTERING; SUBSTRATES

41296 (INIS-SU–98, pp. 119) **Temperature fields in thin crystalline semiconductor plates at ion implantation.** Komarov, F.F.; Urbanovich, A.I.; Podlipko, Yu.A.; Chertok, N.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; CRYSTALS; FILMS; ION BEAMS; SILICON; SPECIFIC HEAT; TEMPERATURE DISTRIBUTION; THERMAL CONDUCTIVITY; THERMAL DIFFUSIVITY

41297 (INIS-SU–98, pp. 122) **Study of nitrogen ion-implantated silicon layers using nuclear reactions and proton backscattering.** Arbuzov, V.Ya.; Bagaev, V.N.; Grande, I.Yu.; Kozhevina, E.V.; Korobejnikov, V.P.; Pyatkova, T.M.; Starikova, T.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; ALPHA PARTICLES; ANNEALING; BACKSCATTERING; CARBON 12; GAMMA RADIATION; KEV RANGE 100-1000; LAYERS; MONOCRYSTALS; NITROGEN 15 BEAMS; PROTON CHANNELING; PROTON REACTIONS; RECRYSTALLIZATION; SILICON

41298 (INIS-SU–98, pp. 124) **Amorphization of ion-irradiated doped Si in conditions of discrepancy between fundamental and impurity atoms.** Gretzschel, R.; Dvurechenskij, A.V.; Popov, V.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; AMORPHOUS STATE; ARSENIC ADDITIONS; BORON ADDITIONS; CRYSTAL DOPING; EPITAXY; FRENKEL DEFECTS; LAYERS; NEON IONS; PHOSPHORUS ADDITIONS; SILICON

41299 (INIS-SU–98, pp. 125) **Study of the depth dependence of a cross spread of ion ranges.** Burenkov, A.F.; Kurganov, A.G.; Konoplyanik, G.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ION IMPLANTATION/range; RANGE; MONTE CARLO METHOD; SPATIAL DISTRIBUTION; STOPPING POWER; TWO-DIMENSIONAL CALCULATIONS

41300 (INIS-SU–98, pp. 127) **Account of orientational effects when calculating ion-implantation profile in a random direction of a crystal.** Kadmenskij, A.G.; Fajzrakhmanov, V.R.;

Shurygina, Yu.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ION IMPLANTATION/orientation; BINARY ENCOUNTER METHOD; CRYSTAL DEFECTS; CRYSTALS; ION CHANNELING; ORIENTATION; MONTE CARLO METHOD; RANGE

41301 (INIS-SU–98, pp. 128) **Calculation of a phosphorus ion range in silicon axial channels.** Kadmenskij, A.G.; Shurygina, Yu.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

PHOSPHORUS IONS/range; SILICON/ion implantation; AMORPHOUS STATE; ENERGY LOSSES; ION CHANNELING; KEV RANGE 10-100; RANGE; SILICON; STOPPING POWER

41302 (INIS-SU–98, pp. 129) **Impurity penetration under the edge of the image at ion implantation of GaAs.** Volod'ko, V.G.; Golubeva, N.G.; Karmanov, V.T. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

GALLIUM ARSENIDES/ion implantation; ANNEALING; SELENIUM IONS; SPATIAL DISTRIBUTION; TWO-DIMENSIONAL CALCULATIONS; VERY HIGH TEMPERATURE

41303 (INIS-SU–98, pp. 132) **Study of the crystal structure and microstructure of cadmium-mercury-tellurium Xe^+-implanted crystals.** Ibragimova, M.I.; Khajbullin, I.B.; Sainov, N.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

CADMIUM/ion implantation; MERCURY/ion implantation; TELLURIUM/ion implantation; CADMIUM; CRYSTAL STRUCTURE; CRYSTAL-PHASE TRANSFORMATIONS; KEV RANGE 10-100; MERCURY; MICROSTRUCTURE; MONOCRYSTALS; RADIATION DOSES; REFLECTION; TELLURIUM; XENON IONS

41304 (INIS-SU–98, pp. 133) **Effect of SiO_2 film on the defectiveness of implanted GaAs layers.** Boyarko, E.Yu.; Malyutin, V.M.; Kryuchkov, Yu.Yu.; Koshcheev, V.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

GALLIUM ARSENIDES/crystal defects; GALLIUM ARSENIDES/ion implantation; SILICON OXIDES/crystal defects; SILICON OXIDES/ion implantation; FILMS; HELIUM IONS; ION CHANNELING; KEV RANGE 100-1000; ORIENTATION; PLATES; SILICON IONS

41305 (INIS-SU–98, pp. 134) **Defect formation in GaAs at silicon multicharged ion implantation.** Bondareva, T.K.; Boyarko, E.Yu.; Verigin, A.A.; Kryuchkov, Yu.Yu.; Malyutin, V.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

GALLIUM ARSENIDES/crystal defects; GALLIUM ARSENIDES/ion implantation; CRYSTAL-PHASE TRANSFORMATIONS; MONOCRYSTALS; MULTICHARGED IONS; RADIATION DOSES; SILICON IONS

41306 (INIS-SU–98, pp. 135) **Optical diagnostics of ion-implanted and electron beam-annealed silicon.** Zenkevich, A.V.; Zysin, Ya.Yu.; Kulikauskas, V.S.; Lyudchik, O.R.; Mamontov, A.N.; Nevolin, V.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/electron beams; SILICON/ion implantation; ANNEALING; ANTIMONY IONS; BISMUTH IONS; CRYSTAL LATTICES; CRYSTALS; ENERGY DEPENDENCE; HELIUM IONS; KEV RANGE 10-100; RADIATION DOSES; SILICON; VERY HIGH TEMPERATURE

41307 (INIS-SU–98, pp. 138) **Defect annealing and impurity behaviour in silicon implanted through a SiO_2 film by arsenic.** Bojko, E.B.; Gajduk, P.I.; Kur'yazov, V.D.; Sivitskij, A.G.; Solov'ev, V.S. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; SILICON OXIDES/ion implantation; ANNEALING; ARSENIC IONS; DISLOCATIONS; EPITAXY; FILMS; INTERSTITIALS; KEV RANGE 10-100; RECOILS; RECRYSTALLIZATION; SILICON

41308 (INIS-SU–98, pp. 139) **B^+ implantation into the SiO_2-Si system. Effect of recoils on the secondary defect formation and the properties of p^+-n junctions.** Gajduk, P.I.; Kur'yazov, V.D.; Sarmont, T.V.; Solov'ev, V.S. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; SILICON OXIDES/ion implantation; BORON IONS; DISLOCATIONS; ENERGY LOSSES; FILMS; INTERSTITIALS; KEV RANGE 100-1000; P-N JUNCTIONS; RECOILS; SILICON; STACKING FAULTS; SUBSTRATES

41309 (INIS-SU–98, pp. 140) **Hydrogen trapping centers in silicon crystal implanted by rare gases.** Bezyazychnaya, T.V.; Mudryj, A.V.; Timofeev, A.B.; Ul'yashin, A.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

HYDROGEN/trapping; SILICON/ion implantation; ACTIVATION ENERGY; ARGON IONS; BINDING ENERGY; CRYSTALS; HELIUM IONS; HYDROGEN; TRAPPING; KRYPTON IONS; NEON IONS; SILICON; VACANCIES; XENON IONS

41310 (INIS-SU–98, pp. 141) **Calculation of interstitial diffusion processes during hot ion implantation.** Velichko, O.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; ARSENIC IONS; DIFFUSION; INDIUM IONS; INTERSTITIALS; RANGE; SILICON; SPATIAL DISTRIBUTION

41311 (INIS-SU–98, pp. 142) **Source for metal ion implantation.** Markus, A.M.; Udovenko, V.F.; Velichko, N.I.; Kolybaev, L.K.; Nat, Sh.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

ION SOURCES/aluminium ions; ION SOURCES/ion implantation; ARGON IONS; BEAM PRODUCTION; MAGNETIC FIELDS; METALS; MICRO AMP BEAM CURRENTS; SPUTTERING

41312 (INIS-SU–98, pp. 143) **Effect of original defects near an irradiated surface on the structure and properties of silicon epitaxial films during ion irradiation from the substrate side.** Semin, Yu.A.; Skupov, V.D.; Tetel'baum, D.I.; Shengurov, V.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

SILICON/ion implantation; ARGON IONS; CARRIER DENSITY; EPITAXY; FILMS; KEV RANGE 10-100; LATTICE PARAMETERS; MICROHARDNESS; SILICON; SOLID CLUSTERS; STACKING FAULTS; SUBSTRATES

41313 (INIS-SU–98, pp. 150) **RBS study of the mechanisms of atomic mixing of bicomponent layers.** Tashlykov, I.S. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

NICKEL/ion implantation; ARGON IONS; DIFFUSION; ION BEAMS; KEV RANGE 10-100; MIXING; NICKEL; PLATINUM; RANGE; SILVER; SPUTTERING; SURFACES; TITANIUM

41314 (LA-UR–89-2520) **Off-diagonal Coulomb interactions in the extended Peierls-Hubbard model: Exact diagonalization results.** Campbell, D.K.; Gammel, J.T.; Loh, E.Y. Jr. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8810299–4: Interacting electrons in reduced dimensions, Torino (Italy), 3-7 Oct 1988). Order Number DE89015292/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

For conjugated polymers, the extended Peierls-Hubbard model has been widely accepted as correctly incorporating the effects of both e-p and e-e interactions. In the absence of e-e interactions, the ground state of $(CH)_x$ is the $2k_F$ bond-order wave (BOW) – dimerization/bond alternation – predicted by Peierls theorem. It is now well established that for the weak e-p coupling appropriate to $(CH)_x$, the on-site Coulomb repulsion actually enhances dimerization up to fairly large values ($U > 6t_0$). These results are still widely regarded as counter to the conventional wisdom that Coulomb interactions should suppress the build-up of charge anywhere, on the sites or on the bonds. Since the extended Peierls-Hubbard model incorporates only (lattice) site-diagonal parts of the electron-electron interactions (U, V), and omits the off-diagonal bond-charge repulsions (W,X), it is natural to ask whether this model adequately describes the full consequences of e-e interactions. In the specific context of $(CH)_x$, the potential importance of this omission is readily recognized. Intuitively, the bond-charge repulsion should suppress dimerization, since it opposes the build-up of charge on the bonds. Thus, the absence of W and X terms in the standard extended Peierls-Hubbard models suggests a priori that these models may artificially favor the continuation of dimerization in the half-filled band into the region of intermediate to strong Coulomb interaction. More generally, the omission of terms such as W and X raises significant questions about the appropriateness of Hubbard models for describing e-e interactions in the whole class of novel solid state materials. Thus this issue is extremely important and is, discussed further in this paper. 14 refs., 6 figs.

41315 (LBL–27321) **HREM at orthogonal projections of GaAs islands on silicon.** Ponce, F.A.; Hetherington, C.J.D. Lawrence Berkeley Lab., CA (USA). May 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890847–1: Electron Microscopy Society of America annual meeting, San Antonio, TX (USA), 6-11 Aug 1989). Order Number DE89015236/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

HREM studies typically examine only one projection of a structure and information in the electron beam direction is lost. In most cases, the structure in this direction is uniform and already known, but in others a second projection needs to be observed. This could involve preparing a second specimen sectioned at right angles to the first, or as described here, tilting a specimen through $\pm 45°$ and observing the same volume in orthogonal projections. The specimen used here was of GaAs islands on <001> silicon, examined in the Atomic Resolution Microscope at LBL. 5 refs., 2 figs.

41316 (ORNL/FTR–3324) **[Collaboration with the Institut de Physique Nucleaire, Universite de Paris Sud, on use of skull melting techniques to grow ZrO_2 crystals doped with divalent ions, Orsay, France, March 2–6, 1989]: Foreign trip report.** Finch, C.B. Oak Ridge National Lab., TN (USA). 21 Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015825/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler collaborated with Michel Genet and others at the Institut de Physique Nucleaire to grow CaO-stabilized ZrO_2 single crystals by the skull technique. This effort was the initial state of a program to produce rare-earth-doped ZrO_2 single-crystal specimens to be used in spectroscopic studies at both IPN and ORNL. Because of a re-direction in the research priorities at the IPN and the accompanying dearth of funding for this project, this assignment was terminated with the mutual consent of the two institutions.

41317 (SAND–89-0867C) **Heavy Ion Backscattering Spectrometry (HIBS) for high sensitivity surface impurity detection.** Knapp, J.A.; Doyle, B.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906161–5: Ion beam analysis conference, Kingston (Canada), 26-30 Jun 1989). Order Number DE89014549/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We describe a medium-energy, heavy ion beam (400 keV C^+) technique for backscattering analyses of heavy trace elements on the surface of light substrates. Pulse pileup problems are eliminated by placing a thin (40 $\mu g/cm^2$), self-supporting C foil in front of the surface barrier detector. In the present example the thickness is selected to range out the ions scattered from a Si substrate, while passing ions scattered from heavier impurities. Using this technique, called Heavy Ion Backscattering Spectrometry (HIBS), we show that sensitivities for impurity elements heavier than Ar on a Si substrate are as high as 10^{10} atoms/cm^2 for Au to 5×10^{11} atoms/cm^2 for Fe. 10 refs., 5 figs.

41318 (UCRL–101309) **Atomic and molecular surface and volume processes in the analysis of negative hydrogen discharges.** Hiskes, J.R.; Karo, A.M. Lawrence Livermore National Lab., CA (USA). 3 Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-890697–1: NATO Advanced Study Institute on non-equilibrium processes in partially ionized gases, Acquafredda di Maratea (Italy), 4-17 Jun 1989). Order Number DE89015705/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The principal source of negative ion generation in hydrogen discharges is now recognized to be low-energy electron attachment to $H_2(\nu'')$ molecules excited to the middle portion of the vibrational spectrum. Electron excitation processes are generally taken to be the principal source of $H_2(\nu'')$ generation, with high-energy excitations through the singlet spectrum being the principal excitation process populating the active portion of the vibrational spectrum. A description of the collisional re-excitation from level ν'', to level ν'', requires 15 x 15 matrix of cross sections linking all initial and final levels. These cross sections have been evaluated and incorporated into the modelling code. An additional source of vibrational excitation may be derived from recombination of H_2^+ and H_3^+ ions on the surfaces of the discharge. In this case the molecular ions will impinge with kinetic energies given by the plasma potential, 1–10 eV. In this paper we report the evaluation of $H_2(\nu'')$ resulting from the surface recombination process. The use of low-work-function materials for the discharge surfaces makes possible two additional source of negative ions: the direct formation of negative ions by hydrogen atoms rebounding from the surface, and the dissociation of H_2^- ions formed in the surface selvage. A recent paper has demonstrated the efficacy of Ba surfaces as an active medium for H^- formation. Here we shall extend our discussion to H_2^+, H_3^+ collisions on Ba surfaces and inventory the generation of H, $H_2(\nu'')$, and H^- rebounding from these surfaces. 16 refs., 4 figs.

41319 **FEL applications in laser etching and ablation.** Estler, R.C. (Dept. of Chemistry, Fort Lewis College, Durango, CO (US)); Nogar, N.S. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Much attention has been given recently to the laser etching and photoablation of insulating and polymeric films because of applications to the etching processes involved in the microelectronics industry. Interesting results have been noted for the wavelength dependence of the etching process in both polymeric and ceramic systems. The authors have recently observed direct evidence of changes in ablative mechanism as a function of wavelength for the ablative photodecomposition (APD) of polymethylmethacrylate (PMMA). Using mass spectrometry to monitor directly the volatile products of the APD process, they observed a distinct photochemical threshold for 248 nm $\leq \lambda \leq$ 266 nm. At the longer wavelengths the primary volatile product was monomeric methylmethacrylate, while for the shorter wavelength irradiation, methyl formate was observed to be the dominant gas-phase product.

6561 Superconductivity

Refer also to citation(s) 40444, 40488

41320 (CONF-890718–9) **Transport critical currents in epitaxial $Y_1Ba_2Cu_3O_{7-x}$ thin films.** Christen, D.K.; Klabunde, C.E.; Thompson, J.R.; Kerchner, H.R.; Sekula, S.T.; Feenstra, R.; Budai, J. Oak Ridge National Lab., TN (USA). Jul 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on materials and mechanisms of superconductivity - high-temperature superconductors; Stanford, CA (USA); 23-28 Jul 1989. Order Number DE89015060/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The epitaxial orientation of coevaporated $Y_1Ba_2Cu_3O_{7-x}$ thin films was identified and the transport critical current density J_c characterized. The best c-axis oriented films deposited on (100) $SrTiO_3$ substrate surfaces had properties that approached estimated material limits, with $J_c > 1$ MA/cm^2 in zero magnetic field at 85K, and showed a large dependence on magnetic field orientation, such that $J_c(H\perp c)/J_c(H||c) \simeq 100$ at H = 60 kOe and 77 K. Triaxial [110]- and [103]-oriented films deposited on (110) substrate surfaces had significantly lower T_c and J_c values, and exhibited temperature dependencies indicative of normal weak-link arrays. 8 refs., 2 figs.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 41042

41321 (BONN-AM–89-01) **Adiabatic motion and the structure of quasi-energy surfaces of periodically driven quantum systems.** Breuer, H.P.; Dietz, K.; Holthaus, M. Bonn Univ. (Germany, F.R.). Physikalisches Inst. Mar 1989. 9p. Order Number DE89795128/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

General repercussions of the extraordinarily rich avoided-crossing structure in the parametric dependence of quasi-energies are discussed. A coarse-graining procedure leading to smooth effective quasi-energy surfaces is introduced. New features and their experimental consequences encountered in the attempt of attaining an adiabatic limit are elucidated. (orig.).

41322 (CONF-8905184–1) **Air breakdown in the relativistic limit.** Graham, G.; Roussel-Dupre, R. Los Alamos National Lab., NM (USA); EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations. 19 Apr 1989. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-88NV10617. (CONF-890730–1: Institute of Electrical and Electronics Engineers international conference on plasma science; 19. international conference on phenomena in ionized gases (ICPIG-19), Buffalo, NY (USA), 22-24 May 1989; 10-14 jul 1989). Order Number DE89014093/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

RELFLAP, a relativistic fluid code for high-power microwave propagation through the atmosphere, has been applied to the study of electrical breakdown of air. This code was used to extend the benchmark curve of E/P vs Pτ to the relativistic regime. The lack of a collisional relativistic code has limited the range of this curve in the past. 4 refs., 8 figs.

41323 (CRN-PN–88-39) **Projector bases and algebraic spinors.** Bergdolt, G. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 4p. Order Number DE89903223/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In the case of complex Clifford algebras a basis is constructed whose elements satisfy projector relations. The relations are sufficient conditions for the elements to span minimal ideals and hence to define algebraic spinors.

41324 (FERMILAB-PUB–89/147-A) **A new way to interpret the Dirac equation in a non-Riemannian manifold.** Sirley Marques-Bonham. Fermi National Accelerator Lab., Batavia, IL (USA); Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). Jun 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89015246/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The idea of internal mass terms is shown not be an appropriate hypothesis when it is placed in connection with the components of the generalized (matrix) vierbeins being proportional to the Riemannian (gravitational) vierbeins. It would result in an undesirable canceling of the Electromagnetic and the Yang-Mills components in the generalized metric. Another hypothesis is introduced where the wave function ψ is Taylor expanded in a small parameter p.

41325 (IFT-P–31/88) **Classical approach to higher-derivative gravity.** Accioly, A.J. Instituto de Fisica Teorica, Sao Paulo, SP (Brazil). 1988. 22p. Order Number DE89631649/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Two classical routes towards higher-derivative gravity theory are described. The first one is a geometrical route, starting from first principles. The second route is a formal one, and is based on a recent theorem by Castagnino et.al. [J. Math. Phys. 28 (1987) 1854]. A cosmological solution of the higher-derivative field equations is exhibited which in a classical framework singles out this gravitation theory. (author).

41326 (IFUSP-P–763) **Nonlinear quantum effects in the maser model: a large N scaling behaviour.** Maki, J.N.; Nemes,

M.C.; Pato, M.P. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Dec 1988. 23p. Order Number DE89631631/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The time evolution of the mean photon number is numerically studied for different initial conditions. We find an approximate scaling of the curves for the various values of N when they are plotted against tau = t/N^{α} and the coefficient α, empirically determined, is found to be directly related to the spectral distribution of the initial condition over the exact states. Its value can be obtained from the N-dependence of the relevant eigenvalues. The approximate periodicity of the curves can also be understood in terms of the spectral distribution of the initial condition. (author).

41327 (JINR-E-5-88-565) **Asymptotic expansions of three-identical-particle wave functions at small hyperradius and S-wave potentials.** Pupyshev, V.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 22p. Order Number DE89631628/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Few-Body Syst.

In the framework of the integrodifferential approach the asymptotic expansions of the wave functions are constructed as series in powers of the hyperradius, its logarithm powers and unknown functions of hyperspherical angles. For calculation of these functions a recurrence chain of ordinary second-order differential equations is obtained. The dependence of the asymptotic expansions on the total angular momentum and behaviour of potentials at small distances is investigated. 15 refs.; submitted to Few-Body Syst.

41328 (JINR-R-2-88-515) **Electron potential in the nonlinear electrodynamics as a minimal surface in the Minkowski space.** Shavokhina, N.S. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 3p. (In Russian). Order Number DE89631629/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Pis'ma Zh. Ehksp. Teor. Fiz.

Earlier, the author proved the following theorem: minimal surface in the Minkowski space-time of arbitrary dimension gives a solution of the Born-Infeld equations of the nonlinear electrodynamics. In this letter this theorem is illustrated by the Born solution of the Born-Infeld equations for the potential of stationary electron. 8 refs.; submitted to Pis'ma Zh. Ehksp. Teor. Fiz.

41329 (JINR-R-2-88-569) **Harmonic, nonsymmetric metric, Born-Infeld equations and minimal surfaces.** Shavokhina, N.S. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 4p. (In Russian). Order Number DE89631630/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Izvestiya vuzov. Matematika.

Algebraic and differential properties of the nonsingular, nonsymmetric metric are considered. It is shown that this metric is characterized by a pair of vector and a pair of covector fields essentially connected by two indentities. If these fields are zero, the metric is called harmonic. The latter is a particular case of the nonsymmetric Einstein metric. On the contrary, the nonsymmetric metric. The solutions of the Born-Infeld equations are pointed out which are given by minimal surfaces. 7 refs.; submitted to Izvestiya vuzov. Matematika.

41330 (JINR-R-4-88-574) **Finite-demensional approximation of differential operator of the Yakubovsky equation.** Belyaev, V.B.; Kochkin, V.I.; Kartavtsev, O.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 5p. (In Russian). Order Number DE89631636/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

By means of the method of finite-dimensional approximation of the differential operator in Faddeev-Yakubovsky equations the problem of determining the length of (1+3) scattering for four spinless particles is investigated. In contrast to the previous calculation, expressions have been used without the potential approximation and without cutting off the Green function. As a result, multidimensional integrals have appeard calculated by the Monte Carlo method. The scattering length has been found to be a~ 0,5 Fm. 6 refs.

41331 (LYCEN–88-29) **Transformations generalizing the Levi-Civita, Kustaanheimo-Stiefel, and Fock transformations.** Kibler, M.; Labastie, P. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. Jul 1988. 6p. (CONF-8806395–: 17. International colloquium on group theoretical methods in physics, Sainte-Adele, CA (USA), 27 Jun - 2 jul 1988). Order Number DE89903226/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Preliminary results concerning non-quadratic (and non-bijective) transformations that exibit a degree of parentage with the well known Levi-Civita, Kustaanheimo-Stiefel, and Fock transformations are reported in this article. Some of the new transformations are applied to non-relativistic quantum dynamical systems in two dimensions.

41332 (SAND–89-0643C) **Radiation diffusion in the three-dimensional radiation-hydrodynamics code CTH.** Rottler, J.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–2: American Physical Society topical conference on shock compression of condensed matter, Albuquerque, NM (USA), 14-17 Aug 1989). Order Number DE89015850/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A treatment of radiation diffusion has been developed for implementation in the three-dimensional Eulerian radiation- hydrodynamics code CTH. The implicit energy flow model was derived using the one-temperature diffusion approximation to the radiation transport equation, i.e., the radiation energy is proportional to the fourth power of the material temperature. The Incomplete Choleski-Conjugate Gradient Method is used to solve the differenced equations. Ionization states are obtained using the average atom ionization model, and Rosseland mean opacities are obtained using a simple analytical expression associated with the ionization model. The paper presents a brief derivation of the energy flow model, and a discussion of the implementation of the model in CTH. 5 refs.

41333 (SLAC-PUB–4951) **Finite and discrete relativistic quantum mechanics.** Noyes, H.P. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 28 Mar 1989. 2p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890875–1: 3. international symposium on foundations of quantum mechanics, Tokyo (Japan), 27-31 Aug 1989). Order Number DE89011287/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

QUANTUM MECHANICS/relativity theory; COUPLING CONSTANTS

41334 (UCRL–100236) **Groundwave propagation over very rough terrains.** Bevensee, R.M. Lawrence Livermore National Lab., CA (USA). Jun 1989. 6p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890896–1: 2. international symposium on antennae and EM theory, Shanghai (China), 29 Aug - 1 sep 1989). Order Number DE89014267/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A very powerful method of predicting single-frequency TM_{ρ} ground wave propagation over irregular and/or inhomogeneous terrain is by a Volterra integral equation, based on Compensation Theorem for inhomogeneities. Such a treatment utilizes terrain elevation and surface impedance profiles and neglects backscatter and variations transverse to the propagation path. For very rough terrains, the computed relative field (attenuation) function may become physically unrealistic, indicating the need to include backscatter. For this situation a modified Volterra treatment with a first-order Fredholm integral equation correction is appealing. 4 refs., 1 fig.

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41335 (CEA-DPhPE–89-06) **Conventional sources of fast neutrons in 'cold fusion' experiments.** Cribier, M.; Spiro, M.; Favier, J. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires. Apr 1989. 6p. Order Number DE89903186/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In 'cold fusion' experiments with heavy water a source of neutrons is the dissociation of deuterium induced by alpha particles emitted by natural occurring radioisotopes. We evaluate the rate of

fast neutron emission as a function of the concentration of U, Th, Rn in contact with deuterium and discuss the possibility that the neutrons claimed to have been observed in 'cold fusion' experiments could be due to this conventional source.

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Refer also to citation(s) 40799, 41062, 41065, 41066, 41076

41336 (CONF-8904214–1) **Ignition and burn criteria for D^3He tokamak and spherical torus reactors.** Galambos, J.D.; Peng, Y-K. M. Oak Ridge National Lab., TN (USA). 1989. 34p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 2. international symposium on aneutronic power; Washington, DC (USA); 28-29 Apr 1989. Order Number DE89015059/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

D-^{3}He ignition and burn criteria for tokamaks and spherical torus reactors are examined in a global analysis with profile corrections. Particle confinement and ash buildup effects are included with the power balance, which results in an increased sensitivity of the ignition criteria to losses via brehmsstrahlung and synchrotron radiation. Plasma beta scaling via an $\epsilon\beta_p$ limit provides the needed aspect ratio (A) dependence, and permits an analysis in all A values of the first and second stability regimes. Energy confinement time (τ_E) associated with particle diffusion (τ_p) and energy conduction (τ_c) are used; parabolic profile are assumed with exponents $\alpha_n = 1.0$ and $\alpha_T = 1.5$; and we set $\tau_p = 2\tau_c$. The ignition condition for minimum $n\tau_E$ is found to be sensitive to β but not to the magnetic field. Steady state burn in second stability tokamaks ($\epsilon\beta_p \geq 0.6$) at high A (>4) with average synchrotron wall reflectivities below 95% requires $n\tau_E$ above 5×10^{21} $m^{-3}s$ or strong plasma elongation ($\kappa > 3$). Ignition in a spherical tori can be achieved with wall reflectivities below 80% and at $n\tau_E \leq 10^{21}$ m^{-3} s, without requiring strong plasma shaping or $\epsilon\beta_p > 0.6$. The need to minimize $n\tau_E$ for ignition and burn strongly limits the synchrotron radiation loss to less than 20% of the fusion power for all values of A. Synchrotron power fractions can be increased to 40% by increasing $n\tau_E$ to its upperbound of ignition. Further increases of this fraction can be obtained only by assuming preferential ash removal. 19 refs., 8 figs.

41337 (DOE/ER/53187–T5) **Electron cyclotron heating and current drive in toroidal geometry: Technical progress report.** Kritz, A.H. Hunter Coll., New York, NY (USA). Dept. of Physics. Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER53187. Order Number DE89015935/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The role of electron-cyclotron heating and current drive in a tokamak is based, in part, on the effectiveness of this form of supplementary heating and on the expected ECH current drive efficiency. Work of the Principal Investigator has continued on the development, use and dissemination of numerical tools required in both the planning of ECH experiments and in answering physics questions associated with those experiments. Moreover, we are concerned not only with the propagation of electron cyclotron radiation into the plasma, and the deposition of this radiation there, but also with the excitation and presence of synchrotron radiation and the propagation of that radiation out of the plasma. The ray tracing codes that have been developed for studying ECH heating and current drive, TORAY and TORCH, will be used in our studies for numerically tracing the path of synchrotron radiation. This will allow us to examine in detail the background as well as the enhanced radiation signals that are detected at the edge of the plasma. 15 refs.

41338 (DOE/ER/53241–3) **Maryland magnetic fusion research program: MS speromak: Progress report, November 16, 1988–November 15, 1989.** DeSilva, A.W.; Goldenbaum, G.C.; Griem, H.R. Maryland Univ., College Park, MD (USA). Lab. for Plasma Research. Jul 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER53241. Order Number DE89015813/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The main theme of our present experimentation on MS is to prolong the spheromak lifetime. This research has been concerned with such topics as passive MHD stabilization coils, impurity control and increased energy storage. At the present time the longest lived plasmas appear to be line tied to the liner or reversal coils. The natural consequence of having net flux outside the separatrix and a resistive plasma is that the plasma shrinks in time. At some point in time the plasma is far enough from the liner, or stabilization coils, that it becomes unstable. If we increase the bias field so as to move the separatrix further inside the liner, the plasma becomes unstable earlier as the separatrix moves to a smaller radius in a shorter time than if it starts out outside the liner. We have tried to circumvent this behavior with various configurations of passive conductors used as stabilizing elements. In this paper, we detail some of the machine modifications that have been tried in attempts to produce a stable, long-lived plasma.

41339 (DOE/ER/53266–2) **Plasma confinement theory and transport simulation: Technical progress report, October 15, 1988–October 31, 1989.** Ross, D.W. Texas Univ., Austin, TX (USA). Fusion Research Center. Jun 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER53266. Order Number DE89015126/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An overview of the program has been given in the contract proposal. The principal objectives are: to provide theoretical interpretation and computer modelling for the TEXT tokamak, and to advance the simulation studies of tokamaks generally, functioning as a National Transport Center. We also carry out equilibrium and stability studies in support of the TEXT upgrade, and work has continued on Alfven waves and MFENET software development. The focus of the program is to lay the groundwork for detailed comparison with experiment of the various transport theories to improve physics understanding and confidence in predictions of future machine behavior. This involves: to collect, in retrievable form, the data from TEXT and other tokamaks; to make the data available through easy-to-use interfaces; to develop criteria for success in fitting models to the data; to maintain the Texas transport code CHAPO and make it available to users; to collect theoretical models and implement them in the transport code; and to carry out simulation studies and evaluate fits to the data. In the following we outline the progress made in fiscal year 1989. Of special note are the proposed participation of our data base project in the ITER program, and a proposed q-profile diagnostic based on our neutral transport studies. We have emphasized collaboration with the TEXT experimentalists, making as much use as possible of the measured fluctuation spectra. 52 refs.

41340 (DOE/ER/53267–2) **Texas experimental tokamak: Technical progress report, October 15, 1988–October 16, 1989.** Wootton, A.J. Texas Univ., Austin, TX (USA). Fusion Research Center. 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER53267. Order Number DE89015152/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report briefly describes research at the text tokamak. The topics include: impurity transport; edge turbulence; ion energy confinement; internal turbulence; externally produced resonant fields; MHD studies; plasma diagnostics; ECR heating and text upgrade. (LSP)

41341 (DOE/ET/53088–5) **[Establishing and hosting an Institute for Fusion Studies]: Technical progress report for period November 1, 1988–October 31, 1989.** Baldwin, D.E. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Jul 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. Order Number DE89015811/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Significant progress was made during the past year in carrying out theoretical investigations pursuant to the scientific mission of the Institute. These achievements may be approximately classified in terms of the following categories (often with considerable overlap): sawteeth and MHD studies, turbulence theory and plasma transport, computational plasma physics, stability theory, mathematical physics, advanced ideas, and space plasma physics-related problems. An overview of this work is contained in this report. Detailed summaries of IFS Reports written during FY 89 are given in abstract form.

41342 (FRNC-TH–3341) **Pumped limiter results on TFR Tokamak plasma.** Linet, F.L. Institut Superieur des Materiaux et de

Construction Mecanique, 93 - Saint-Ouen (France). Jan 1987. 255p. (In French). Order Number DE89903170/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

Pump limiter experiments are carried out in the TFR Tokamak. The pump limiter is located in the outer part of the torus, its double-throat head is made of graphite tiles and it is pumped by a 2000 ls^{-1} titanium sublimation pump. The first attempts showed that the exhaust efficiency of this pump limiter was low (ϵ = 1.5% of the total plasma particle efflux). To improve these results, a new limiter head with a single longer throat has been built; particles were better trapped and the pumping provided an important decrease of the recycling coefficient. Geometric features mainly explain the increase by a factor 3.5 of the exhaust efficiency (ϵ = 5.5%). Ion temperature of the order of a few eV has been deduced from Doppler broadening measurements at the neutralizer plate of the pump limiter.

41343 (IAE–4672/7) **Laser probing non-cylindrical z-pinch in near-isolator region of a discharged chamber.** Mikhajlov, V.I.; Orlov, M.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 9p. (In Russian). Order Number DE89632018/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Physical processes reducing the effectiveness of radiation characteristics of the non-cylindrical Z-pinch are considered. One of the processes studied is the secondary break-down of discharge space with the formation of a current channel shunting the main current of the discharge circuit and spatially localized along insulator surface. The experiments are performed using the plasma focus type device. Deuterium and xenon mixture with partial pressures ratio ~ is the working gas. The working pressure of the mixture varied within 0.4-0.7 Torr. The probing is performed by ruby laser with modulated quality factor included into the circuit of interferometric measurements. The main attention is paid to the processes in the near-insulator discharge chamber region. 9 refs.; 6 figs.

41344 (IAE–4732/16) **Numerical simulation of laser radiation propagation in non-uniform absorbing medium. Geometrical optics approximation.** Bol'shov, L.A.; Vorob'ev, V.A.; Kanevskij, M.F.; Kanyukova, V.D.; Yudin, A.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 23p. (In Russian). Order Number DE89632014/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The algorithm of numerical study of coherent radiation propagation in the approximation of geometrical optics in the inhomogeneous absorbing medium is suggested and developed. The results of test calculations are given. The results of model calculations of powerful laser radiation with plasma are presented. 8 refs.; 12 figs.

41345 (IPP–5/27) **Integral constitutive relation for the investigation of ion Bernstein waves in non-homogeneous plasmas.** Brambilla, M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Jan 1989. 24p. Order Number DE89794785/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

By integrating the linearised Vlasov equation, we derive an integral form of the constitutive relation (the relation between the h.f. electric field $E^{->}$ and the h.f. current $J^{->}$) valid to all orders in the Larmor radius in axially magnetised inhomogeneous plasmas. It has the form of a convolution integral in Fourier $k^{->}_{perpendicular\ to}$-space, whose kernel can be expanded in Bessel functions, or put in a form analogous to the Gordeev integral form of the usual uniform plasma conductivity tensor, to which it reduces in the uniform plasma limit. Alternatively, it can be formulated as an integral equation in real space. Both formulations can be useful for the investigation of ion Bernstein waves near ion cyclotron resonances and near the lower hybrid resonance, where a WKB analysis alone is insufficient. (orig.).

41346 (JET-R–88-19) **JET belt limiter tiles.** Deksnis, E. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Sep 1988. 13p. Order Number DE89632021/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The belt limiter system, comprising two full toroidal rings of limiter tiles, was installed in JET in 1987. In consists of water-cooled fins with the limiter material in form of tile inbetween. The tiles are designed to absorb heat fluxes during irradiation without the surface temperature exceeding 2000^{0}C and to radiate this heat between pulses to the water cooled sink whose temperature is lower than that of the vacuum vessel. An important feature of the design is to maximise the area of the radiating surface facing the water cooled fin. This leads to a tile depth much greater than the width of the tile facing the heat flux. Limiter tiles intercept particles flowing out of the plasma through the area between the two belt limiter rings and through remaining surface area of the plasma column. Power deposition to a limiter tile depends strongly on the shape of the plasma, the edge plasma properties as well as on the surface profile of the tiles. This paper will discuss the methodology that was followed in producing an optimized surface profile of the tiles. This shaped profile has the feature that the resulting power deposition profile is roughly similar for a wide range of plasma parameters. (author).

41347 (JET-R–88-20) **Curvature of the JET lower hybrid grill face.** Knowlton, S. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. 1988. 19p. Order Number DE89632016/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The lower hybrid current drive antenna, or grill, to be used on JET will efficiently couple to the plasma if the density in front of the antenna face is in the range n_e = 0.7 - 1.3 x 10^{18} m^{-3}, with the optimal value depending on the relative phase between adjacent multijunction modules of the antenna. The effect on coupling of a limiter in close proximity to the antenna mouth is estimated. The required grill face curvature is calculated based on the local flux surface geometry and is compared to the range of conditions expected in JET, An antenna shape is found which is adequate for most vertically symmetric JET limiter plasmas. (author).

41348 (KFKI–1989-01/D) **Possible method for ion temperature measurement by ion sensitive probes.** Kocsis, G.; Koltai, L. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Jan 1989. 12p. Order Number DE89632019/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A new method for magnetically confined plasma ion temperature measurement is suggested based on the different Larmor radii of electrons and ions. An electric probe was constructed which is the advanced version of the ion sensitive probe proposed by Katsumata. The new probe separates the ion component of the plasma from that of the electrons by their different Larmor radii in the magnetized plasma. It is shown that by using several such probes of different electrode depths the parameters of the ion component can be measured instanteously. The applicability of the method was verified by simple model calculation. (R.P.) 6 refs.; 3 figs.

41349 (PPPL–2603) **A poloidal field measurement technique: Pitch angle measurements via injected Hesup + Ions.** Jobes, F.C. Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014415/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The poloidal field of a tokamak can be determined by observing the light emitted by He^+ ions injected into the plasma by a perpendicular He^0 beam. These ions will orbit in small circles located where the neutral atom became ionized, and they will remain there for a few microseconds. During this time, some of these ions will also emit light at various spectral lines. The observed spectrum of any of these lines will have a peculiar and very wide shape, and it will be offset (Doppler shifted) with respect to the natural line location. The location and width of the spectral pattern provide independent information about the components of the poloidal field which are parallel and perpendicular to the beam velocity, and this information is local to the point where the light is emitted. For a horizontal beam, these components are b_x and b_y, respectively. The difference in Doppler shift between two measurement points above one another (at the top and bottom of the beam) is directly proportional to δb_x, which in turn is proportional to the transform on that flux surface. Thus, this technique provides a means to measure directly local values of q(r). Simulation studies indicate that accurate measurements can be made in milliseconds. 6 refs., 8 figs.

41350 (PPPL–2632) **An alpha particle diagnostic based on measurements of lower hybrid wave fluctuations.** Wong, K.L.

Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014414/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It is shown that the one-dimensional alpha particle velocity distribution function can be determined from the fluctuation- dissipation theorem based on measurements of lower hybrid wave fluctuations in an equilibrium plasma. This method uses collective Thomson scattering data with large signal-to-noise ratio, but it is applicable only when the alpha particles have an isotropic velocity distribution. 16 refs., 1 fig.

41351 (PPPL–2635) **Toroidal microinstability studies of high temperature tokamaks.** Rewoldt, G.; Tang, W.M. Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014336/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results from comprehensive kinetic microinstability calculations are presented showing the effects of toroidicity on the ion temperature gradient mode and its relationship to the trapped-electron mode in high-temperature tokamak plasmas. The corresponding particle and energy fluxes have also been computed. It is found that, although drift-type microinstabilities persist over a wide range of values of the ion temperature gradient parameter $\eta_i \equiv (d\ln T_i/dr)/(d\ln n_i/dr)$, the characteristic features of the dominant mode are those of the η_i-type instability when $\eta_i > \eta_{ic} \sim 1.2$ to 1.4 and of the trapped-electron mode when $\eta_i < \eta_{ic}$. 16 refs., 7 figs.

41352 (PPPL–2636) **Confinement and power balance in the S-1 spheromak.** Levinton, F.M.; Meyerhofer, D.D.; Mayo, R.M.; Janos, A.C.; Ono, Y.; Ueda, Y.; Yamada, M. Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014342/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The confinement and scaling features of the S-1 spheromak have been investigated using magnetic, spectroscopic, and Thomson scattering data in conjunction with numerical modeling. Results from the multipoint Thomson scattering diagnostic shows that the central beta remains constant ($\beta_{to} \sim 5\%$) as the plasma current density increases from 0.68–2.1 MA/m^2. The density is observed to increase slowly over this range, while the central electron temperature increases much more rapidly. Analysis of the global plasma parameters shows a decrease in the volume average beta and energy confinement as the total current is increased. The power balance has been modeled numerically with a 0-D non-equilibrium time-dependent coronal model and is consistent with the experimental observations. 20 refs., 12 figs., 2 tabs.

41353 (PPPL–2637) **Loop-voltage tomography in tokamaks using transient synchrotron radiation.** Fisch, N.J.; Kritz, A.H. Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014343/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The loop voltage in tokamaks is particularly difficult to measure anywhere but at the plasma periphery. A brief, deliberate, perturbation of hot plasma electrons, however, produces a transient radiation response that is sensitive to this voltage. We investigate how such a radiation response can be used to diagnose the loop voltage. 24 refs., 6 figs.

41354 (UCID–21574-Rev.1) **A compendium of computer codes for the researcher in magnetic fusion energy: Revision 1.** Porter, G.D. Lawrence Livermore National Lab., CA (USA). 19 Jun 1989. 72p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. Order Number DE89014370/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

When starting the search for computational tools to address a question about plasma physics, a person may be quickly overwhelmed by the number of these tools that are available. This compendium of computer codes available to the fusion researchers is intended to make it easier to determine what already exists. I hope that the list of computer codes will enable the experimentalist to find the tools necessary both to thoroughly analyze his/her data and to determine how those data compare with theoretical models. The National Fusion Program is dominated by research in toroidal geometry; hence most of the codes listed here are useful for this research. However, some work continues in open geometry, so I have also included those codes that I think useful for research in thee areas. I am gearing this list towards the needs of experimentalists and have tried to provide the information that will be of value to them. Specifically, I expect that an experimentalist may need several different codes to fully analyze the data, and that it will be valuable to be able to transfer data from one code to another. One powerful tool for this job, BASIS, is described. Many codes are available on the National Magnetic Fusion Energy Computer Center's Crays. A description of these codes can be obtained on-line. I have included some, but by no means all, of these codes in this compendium. In general, I have tried to provide a summary of the information available in Ref. 125. Other code descriptions included here have been copied nearly verbatim from the references describing the codes. In some cases, little information is available. The information includes a brief description of the code, a bibliography of the documentation available for the code and/or the underlying physics, a list of people to contact for help in running the code, instructions on how to access the code, and a description of the output from the code. 138 refs.

41355 **VUV free-electron lasers as diagnostic probes of magnetic fusion plasmas.** Peebles, W.A. (Institute for Plasma Fusion Research, UCLA, Los Angeles, CA (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

This paper describes the possible application of VUV free-electron lasers to probe the role of neutral particles in the magnetic confinement fusion plasmas.

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41356 (ANL/FPP/TM–237) **The thermophysical and transport properties of eutectic NaK near room temperature.** O'Donnell, W.J.; Papanikolaou, P.G.; Reed, C.B. Argonne National Lab., IL (USA). Fusion Power Program. Feb 1989. 50p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE89013918/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The purpose of this report is to compile recommended room temperature thermophysical properties of NaK_{78}. The report was prepared to provide a single unified collection of property values for the eutectic sodium-potassium alloy. These properties include density, kinematic and absolute viscosities, thermal conductivity, specific heat, electrical resistivity, electrical conductivity, Prandtl number, and thermal diffusivity. Each section of the report contains a completely referenced property that focuses in the 0–80°C temperature range. All available data for each property have been taken from original publications. The individual sections are organized following a specific outline, considering: discussion of experimental methods, discussion of sources and error, discussion of each reference, tabular presentation of all available data, graphical presentation of the data, recommendations, tabular presentation of recommended values, an equation to calculate recommended values, and a graphical presentation of the recommended curve (0–80°C) generated from the above equation. Also included are experimental methods, whether the references included equations to fit the data, and whether or not these references were primary sources. 26 refs., 12 figs., 14 tabs.

41357 (CEA-N–2604) **Shock wave propagation in a neutron cloud.** Munier, A. CEA Centre d'Etudes de Limeil, 94 - Vilieneuve-Saint-Georges (France). Apr 1989. 14p. (In French). Order Number DE89903173/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We propose to study the speed putting of neutron population by a shock wave.

41358 (CONF-890701–1) **Experience in the operation of the International Fusion Superconducting Magnet Test Facility.** Fietz, W.A. Oak Ridge National Lab., TN (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International cryogenic materials conference; Los Angeles, CA (USA); 24-28 Jul 1989. Order Number DE89015353/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The International Fusion Superconducting Magnet Test Facility (IFSMTF) was placed under vacuum in October 1985 and cooled in January 1986. It remained at cryogenic temperatures until September 1987, when testing was completed. This paper is an account of the activities of cooling, testing, and maintaining the system during this period. The facility contained six superconducting magnets, arranged in a toroidal array. Each of these D-shaped magnets weighed 40-50 tonnes and was about 5 m by 10 m. The refrigerator system provided atmospheric liquid helium (LHe), about 5000 L in the three pool-boiling coils and the leads, plus a storage capacity of 21,000 L. In addition, the three forced-flow coils were supplied with up to 300 g/s of single-phase helium at 3.8 K and 15 atm. A crew of three or four trained, certified operators handled the cryogenic facility on a 24-h basis for most of the daily activities. Detailed records were maintained, reports of unusual events were prepared and a continuous record of availability was accumulated. At the end of the 22-month period of operation, the cumulative availability was 57%. 1 ref., 13 figs., 2 tabs.

41359 (CONF-890791–2) **High-power microwave transmission and launching systems for fusion plasma heating systems.** Bigelow, T.S. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From NSF workshop on future directions in electromagnetics research; Boston, MA (USA); 25-27 Jul 1989. Order Number DE89015063/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Microwave power in the 30- to 300-GHz frequency range is becoming widely used for heating of plasma in present-day fusion energy magnetic confinement experiments. Microwave power is effective in ionizing plasma and heating electrons through the electron cyclotron heating (ECH) process. Since the power is absorbed in regions of the magnetic field where resonance occurs and launching antennas with narrow beam widths are possible, power deposition location can be highly controlled. This is important for maximizing the power utilization efficiency and improving plasma parameters. Development of the gyrotron oscillator tube has advanced in recent years so that a 1-MW continuous-wave, 140-GHz power source will soon be available. Gyrotron output power is typically in a circular waveguide propagating a circular electric mode (such as $TE_{0,2}$) or a whispering-gallery mode (such as $TE_{15,2}$), depending on frequency and power level. An alternative high-power microwave source currently under development is the free-electron laser (FEL), which may be capable of generating 2-10 MW of average power at frequencies of up to 500 GHz. The FEL has a rectangular output waveguide carrying the $TE_{0,1}$ mode. Because of its higher complexity and cost, the high-average-power FEL is not yet as extensively developed as the gyrotron. In this paper, several types of operating ECH transmission systems are discussed, as well systems currently being developed. The trend in this area is toward higher power and frequency due to the improvements in plasma density and temperature possible. Every system requires a variety of components, such as mode converters, waveguide bends, launchers, and directional couplers. Some of these components are discussed here, along with ongoing work to improve their performance. 8 refs.

41360 (DOE/ET/51013–267) **Analytic theory of the gyrotron.** Lentini, P.J. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. c Jun 1989. 33p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/RR–89-6). Order Number DE89014856/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An analytic theory is derived for a gyrotron operating in the linear gain regime. The gyrotron is a coherent source of microwave and millimeter wave radiation based on an electron beam emitting at cyclotron resonance Ω in a strong, uniform magnetic field. Relativistic equations of motion and first order perturbation theory are used. Results are obtained in both laboratory and normalized variables. An expression for cavity threshold gain is derived in the linear regime. An analytic expression for the electron phase angle in momentum space shows that the effect of the RF field is to form bunches that are equal to the unperturbed transit phase plus a correction term which varies as the sine of the input phase angle. The expression for the phase angle is plotted and bunching effects in and out of phase (0 and $-\pi$) with respect to the RF field are evident for detunings leading to gain and absorption, respectively. For exact resonance, field frequency $\omega = \Omega$, a bunch also forms at a phase of $-\pi/2$. This beam yields the same energy exchange with the RF field as an unbunched, (nonrelativistic) beam. 6 refs., 10 figs.

41361 (DOE/ET/51013–268) **Velocity diagnostics of electron beams within a 140 GHz gyrotron.** Polevoy, J.T. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. c Jun 1989. 65p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/RR–89-7). Order Number DE89014857/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Experimental measurements of the average axial velocity $v_{||}$ of the electron beam within the M.I.T. 140 GHz MW gyrotron have been performed. The method involves the simultaneous measurement of the radial electrostatic potential of the electron beam V_p and the beam current I_b. V_p is measured through the use of a capacitive probe installed near or within the gyrotron cavity, while I_b is measured with a previously installed Rogowski coil. Three capacitive probes have been designed and built, and two have operated within the gyrotron. The probe results are repeatable and consistent with theory. The measurements of $v_{||}$ and calculations of the corresponding transverse to longitudinal beam velocity ratio $\alpha = v_{\perp}/v_{||}$ at the cavity have been made at various gyrotron operation parameters. These measurements will provide insight into the causes of discrepancies between theoretical rf interaction efficiencies and experimental efficiencies obtained in experiments with the M.I.T. 140 GHz MW gyrotron. The expected values of $v_{||}$ and α are determined through the use of a computer code entitled EGUN. EGUN is used to model the cathode and anode regions of the gyrotron and it computes the trajectories and velocities of the electrons within the gyrotron. There is good correlation between the expected and measured values of α at low α, with the expected values from EGUN often falling within the standard errors of the measured values. 10 refs., 29 figs., 2 tabs.

41362 (DOE/ET/51013–270) **Alcator C-MOD final safety analysis.** Fiore, C.L. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jun 1989. 101p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/RR–89-8). Order Number DE89015786/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This document is designed to address the safety issues involved with the Alcator C-Mod project. This report will begin with a brief description of the experimental objectives which will be followed by information concerning the site. The Alcator C-Mod experiment is a pulsed fusion experiment in which a plasma formed from small amounts of hydrogen or deuterium gas is confined in a magnetic field for short periods (~1 s). No radioactive fuels or fissile materials are used in the device, so that no criticality hazard exists and no credible nuclear accident can occur. During deuterium operation, the production of a small number of neutrons from a short pulse could result in a small amount of short- and intermediate-lived radioactive isotopes being produced inside the experimental cell. This report will demonstrate that this does not pose an additional hazard to the general population. The health and safety hazards resulting from Alcator C-Mod occur to the workers on the experiment, each of which is described in its own chapter with the steps taken to minimize the risk to employees. These hazards include fire, chemicals and cryogenics, air quality, electrical, electromagnetic radiation, ionizing radiation, and mechanical and natural phenomena. None of these hazards is unique to the facility, and methods of protection from them are well defined and are discussed in the chapter which describes each hazard. The quality assurance program, critical to ensuring the safety aspects of the program, will also be described.

41363 (DOE/ID/01570–4) **The chemical kinetics of the reactions of lithium with steam-air mixtures.** Barnett, D.S.; Kazimi, M.S. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Apr 1989. 247p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (PFC/RR–89-3). Order Number DE89015788/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This work involved the experimental and analytical determination of the consequences of lithium fires in the presence of steam. Experiments were performed to characterize the chemical reactions of lithium with steam-nitrogen and steam-air mixtures. Models were introduced in the LITFIRE code to describe lithium fires in the presence of steam inside the containment building and plasma chamber of a hypothetical fusion reactor. The code was also equipped with the capability to determine the effects of decay heat and lithium fire on the temperature response of the reactor first wall in the event of a coolant disturbance. Forty-two kinetics experiments were performed in which a stream of steam-nitrogen or steam-air was passed over and reacted with approximately three grams of lithium heated to a predetermined temperature. The lithium reaction rates with the constituent gases were measured and characterized for a wide range of lithium temperatures and gas compositions. Experiments were performed with steam molar concentrations of 5, 15 and 30% and lithium temperatures ranging from 400 to 1100°C, inclusive. The LITFIRE code was modified to enable it to model the interactions of lithium with steam-air atmospheres. Results of the reaction kinetics experiments were used in the reaction model, and the heat transfer model was expanded to allow it to handle condensible atmospheres. Three groups of accidents were investigated: a spill on the containment building floor, a spill inside the reactor plasma chamber, and a spill inside the plasma chamber with steam injection to the containment building simulating a steam line break. The results were compared to dry air cases under the same conditions. 23 refs., 66 figs., 18 tabs.

41364 (DOE/ID/01570–5) **Litfire user's guide: Third edition.** Barnett, D.S. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Apr 1989. 152p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (PFC/RR–89-4). Order Number DE89015787/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

LITFIRE is a computer code which simulates lithium fires in fusion reactors by generating the time histories of the temperature and pressure profiles occurring in a reactor containment in response to a lithium or lithium-lead eutectic spill and fire. The fire may take place in a single cell connected to an optional second cell, or in an insulated pan in a single cell. The lithium or lithium-lead may react with any mixture of oxygen, nitrogen or water vapor; an inert gas may also be included in the cell atmospheres. Lithium only may be burned in a carbon dioxide atmosphere without oxygen. An option for liquid metal-concrete interaction is available as well as the following options for mitigating the effects of a fire: gas flooding, emergency space cooling, emergency floor cooling, aerosol removal and gas injection. This user's guide includes a brief description of the physics of lithium fires, the workings of the code and the options available to users, and also includes a listing of the code with a complete glossary of variables used in LITFIRE. The present version of LITFIRE is available on the PFCVAX at MIT and on the Crays at the National Magnetic Fusion Energy Computer Center (NMFECC, hereafter referred to as MFE). It is written in FORTRAN 77 and is compatible with the computing facilities at which it is located. The instructions present in this guide will enable a user to execute the code at either location. 4 refs., 5 figs.

41365 (DOE/OR/00033–T428) **Tritium breeding and release-rate kinetics from neutron-irradiated lithium oxide.** Quanci, J.F. Oak Ridge Associated Universities, Inc., TN (USA). Jan 1989. 423p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-76OR00033. Order Number DE89015495/JAW. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

Thesis. Submitted to Princeton University, NJ.

The research encompasses the measurement of the tritium breeding and release-rate kinetics from lithium oxide, a ceramic tritium-breeding material. A thermal extraction apparatus which allows the accurate measurement of the total tritium inventory and release rate from lithium oxide samples under different temperatures, pressures and carrier-gas compositions with an uncertainty not exceeding 3% was developed. The goal of the Lithium Blanket Module program was to determine if advanced computer codes could accurately predict the tritium production in the lithium oxide blanket of a fusion power plant. A fusion blanket module prototype was built and irradiated with a deuterium-tritium fusion-neutron source. The tritium production throughout the module was modeled with the MCNP three dimensional Monte Carlo code and was compared to the assay of the tritium bred in the module. The MCNP code accurately predicted tritium-breeding trends but underestimated the overall tritium breeding by 30%. The release rate of tritium from small grain polycrystalline sintered lithium oxides with a helium carrier gas from 300 to 450 C was found to be controlled by the first order surface desorption of monotritiated water. When small amounts of hydrogen were added to the helium carrier gas, the first order rate constant increased from the isotopic exchange of hydrogen for tritium at the lithium oxide surface occurring in parallel with the first order desorption process. The isotopic-exchange first order rate constant temperature dependence and hydrogen partial pressure dependence were evaluated.

41366 (EUR–11955) **Lifetime evaluation for thermal fatigue: application at the first wall of a tokamak fusion reactor.** Merola, M.; Biggio, M. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 303p. (In Italian). Available from NTIS (US Sales Only), PC A14/MF A01.

Thermal fatigue seems to be the most lifetime limiting phenomenon for the first wall of the next generation Tokamak fusion reactors. This work deals with the problem of the thermal fatigue in relation to the lifetime prediction of the fusion reactor first wall. The aim is to compare different lifetime methodologies among them and with experimental results. To fulfil this purpose, it has been necessary to develop a new numerical methodology, called reduced-3D, especially suitable for thermal fatigue problems.

41367 (GSI–89-41(prepr.)) **Status and perspectives of heavy ion inertial fusion.** Bock, R. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Apr 1989. 12p. (CONF-890388–: 4. European Physical Society (EPS) seminar on international research facilities, Zagreb (Yugoslavia), 17-19 Mar 1989). Order Number DE89795126/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

For energy production by inertial confinement fusion the heavy ion accelerator is the most promising driver candidate. A conceptual design study, HIBALL, showed for the first time that a concept of an accelerator driven power station should be feasible. Two accelerator concepts, an rf-linac with storage rings and an induction linac, both investigated in the framework of national programs during the last decade, can be seriously taken into account as driver candidates. Two accelerator facilities now under construction or design, SIS/ESR at GSI and MBE-4/ISLE at LBL, are conceived to study key issues of both driver concepts. Present activities and some new ideas on driver concepts are reviewed. (orig.).

41368 (JAERI-M–88-205) **TSTA loop operation with 100 grams-level of tritium. Milestone run in July, 1987.** Yoshida, Hiroshi; Hirata, Shingo; Naito, Taisei and others. Japan Atomic Energy Research Inst., Tokyo (Japan). Oct 1988. 66p. Order Number DE89790756/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The first loop operation tests of Tritium Systems Test Assembly with 100 grams-level of tritium had been completed at Los Alamos National Laboratory in July, 1987. This test was the resumption of the previous milestone run halted on 26 June due to a mechanical failure of the refrigerator for the hydrogen isotope separation system. The objectives were (i) to operate the TSTA process loop for a week to demonstrate its major process systems such as the fuel cleanup system and the hydrogen isotope separation system, (ii) to demonstrate the safety systems such as the secondary containment system, tritium waste treatment system and tritium monitoring system, and to obtain handling experience with a large amount of tritium. This report describes characteristics of the safety systems observed during the milestone run.

41369 (KEK–88-7, pp. 53-65) **Development of an intense negative ion source for a neutral beam injector in the next fusion machine.** Ohara, Y. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba (Japan), 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A negative-ion-based neutral beam injection system is expected to be used for plasma heating and plasma current drive in the next fusion machine. One of the most important components to realize this system for the Fusion Experimental Reactor is to develop a 500 keV, 92 A deuterium negative ion source. Recent experimental results indicate that a volume production source is the most promising in that it has a potentiality to produce high current negative ion beams. A volume source developed at JAERI has already attained a multi-ampere H^- extraction. The peak H^- current density was 22mA/cm^2 at the exit of the ion source and about 35mA/cm^2 at the plasma boundary.

41370 (PNL-SA–16217) **A fast neutron, in situ tritium recovery experiment on solid breeder materials.** Hollenberg, G.W.; Kurasawa, T.; Watanabe, H.; Berk, S.E.; Hastings, I.J.; Miller, J.; Baker, D.E.; Bauer, R.E.; Puigh, R.J. Pacific Northwest Lab., Richland, WA (USA). Oct 1988. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-881031–71: 8. topical meeting on technology of fusion energy, Salt Lake City, UT (USA), 9-13 Oct 1988). Order Number DE89014444/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An in situ tritium recovery experiment has been designed and is being fabricated for the irradiation of Li_2O in the Fast Flux Test Facility, FFTF. Two in situ tritium recovery canisters will be irradiated with lithium atom burnups to 4%. One canister will provide fundamental data on tritium release as a function of temperature, gas composition, and flow rate. The other canister will contain solid pellet specimens with large (430°C) radial temperature gradients in order to provide integrated performance data. 11 refs., 5 figs., 1 tab.

41371 (PPPL–2627) **A D-He^3 fusion reactor based on a dipole magnetic field.** Hasegawa, Akira; Chen, Liu. Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014416/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An innovative fusion reactor suitable for D-He^3 fuel is proposed, based on a dipole magnetic field produced by a simple one-turn coil with $\lesssim$16 T near-field intensity. The equilibrium plasma, phase-space density satisfies $\partial f_0(\mu, J, \psi)/\partial\psi = 0$, where ψ is the flux function, has a steep enough pressure profile for an efficient fusion reaction yet is stable for low frequency instabilities to local beta exceeding unity. The semi-open field configuration is particularly suitable for D-He^3 reactions. 8 refs., 1 fig.

41372 (PPPL–2633) **End points in discharge cleaning on TFTR [Tokamak Fusion Test Reactor].** Mueller, D.; Dylla, H.F.; Bell, M.G.; Blanchard, W.R.; Bush, C.E.; Gettelfinger, G.; Hawryluk, R.J.; Hill, K.W.; Janos, A.C.; Jobes, F.C. Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014335/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

It has been found necessary to perform a series of first-wall conditioning steps prior to successful high power plasma operation in the Tokamak Fusion Test Reactor (TFTR). This series begins with glow discharge cleaning (GDC) and is followed by pulse discharge cleaning (PDC). During machine conditioning, the production of impurities is monitored by a Residual Gas Analyzer (RGA). PDC is made in two distinct modes: Taylor discharge cleaning (TDC), where the plasma current is kept low (15–50 kA) and of short duration (50 ms) by means of a relatively high prefill pressure and aggressive PDC, where lower prefill pressure and higher toroidal field result in higher current (200–400 kA) limited by disruptions at $q(a) \approx 3$ at $\approx$ 250 ms. At a constant repetition rate of 12 discharges/minute, the production rate of H_2O, CO, or other impurities has been found to be an unreliable measure of progress in cleaning. However, the ability to produce aggressive PDC with substantial limiter heating, but without the production of x-rays from runaway electrons, is an indication that TDC is no longer necessary after $\approx 10^5$ pulses. During aggressive PDC, the uncooled limiters are heated by the plasma from the bakeout temperature of 150°C to about 250°C over a period of three to eight hours. This limiter heating is important to enhance the rate at which H_2O is removed from the graphite limiter. 14 refs., 3 figs., 1 tab.

41373 (UCID–21725) **NTES laser facility for physics experiments: Building 381 high bay option.** Christie, D.J.; Foley, R.J.; Frank, D.N.; Henesian, M.A.; Hunt, J.T.; Labiak, W.G.; Larson, D.W.; Lawson, J.K.; Lee, R.W.; Mayo, S.E. Lawrence Livermore National Lab., CA (USA). 12 Jul 1989. 218p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014326/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics on the NTES laser facility: Mission Statement and Project Description; Experiment Area; High-Energy, Double-Pass Laser; Facilities; Laser Control and Data Acquisition; and Auxiliary Lasers.

41374 (UCRL–21207) **Development of dense plasma focus as a soft x-ray source for the study of x-ray damage to laser optics: Final report.** Venneri, F.; Barnouin, O.; Miley, G.H. Lawrence Livermore National Lab., CA (USA). 1989. 23p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015728/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The experiment currently under way at the University of Illinois Dense Plasma Focus is aimed at producing a high intensity X-ray spectrum tailored to the requirements of ICF X-ray emission simulation. This paper discusses the development of this dense plasma focus.

41375 (UCRL–99316-Rev.2) **Damage to large optics by focusing acoustic transients: Revision 2.** Smith, J.R.; Murray, J.R.; Kyrazis, D.T.; Wilcox, R.B.; Weiland, T.L.; Ehrlich, R.B.; Thompson, C.E.; Engle, R.B.; Brown, A.E. Lawrence Livermore National Lab., CA (USA). Apr 1989. 30p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890423–12-Rev.2: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989). Order Number DE89014042/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have observed damage to 80-cm-diam fused-silica disks and lenses subjected to high-fluence pulses (up to 2.3 J/cm^2) from an upgraded Nova laser beamline (wavelength 351 nm; pulse duration 2.35 ns; beam diameter 70 cm; energy up to 8 kJ). Damage occurred in the center of each element, where a 6-cm-wide obscuration prevented direct illumination. We believe that light strongly scattered by transverse stimulated Brillouin scattering (SBS) interacts with the surface and with the bulk of the substrate, producing two kinds of acoustic waves that propagate to its center, where they become strong enough to do damage. We propose design rules for avoiding acoustic damage in large optics and compare observed thresholds for transverse SBS with predictions in the literature. 7 refs., 8 figs., 1 tab.

41376 (UCRL–101286) **Prospects for inertial fusion as an energy source.** Hogan, W.J. Lawrence Livermore National Lab., CA (USA). 26 Jun 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890711–2: 5. international conference on emerging nuclear energy systems: ICENES '89, Karlsruhe (Germany, F.R.), 3-6 Jul 1989). Order Number DE89015777/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Progress in the Inertial Confinement Fusion (ICF) Program has been very rapid in the last few years. Target physics experiments with laboratory lasers and in underground nuclear tests have shown that the drive conditions necessary to achieve high gain can be achieved in the laboratory with a pulse-shaped driver of about 10 MJ. Requirements and designs for a Laboratory Microfusion Facility

(LMF) have been formulated. Research on driver technology necessary for an ICF reactor is making progress. Prospects for ICF as an energy source are very promising. 11 refs., 5 figs.

99 GENERAL AND MISCELLANEOUS

Refer also to citation(s) 40083, 40434, 40693

41377 (CONF-8903147–1) **Logistics intra-theater support tool for course of action logistical feasibility analysis.** Macal, C.M.; Van Groningen, C.N.; Widing, M.a.; Duffy, M.K. Argonne National Lab., IL (USA). 1989. 11p. Sponsored by U.S. Department of Defense. DOE Contract W-31109-ENG-38. From Artificial intelligence applications for military logistics symposium; Williamsburg, VA (USA); 21-28 Mar 1989. Order Number DE89015698/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Logistics Intra-theater Support Tool (LIST) is a prototype system that evaluates a course of action for its logical feasibility. LIST addresses the question of whether a theater's infrastructure and strategic lift allocation are adequate to support the movement of specified ground forces and supplies to a given destination by a specified day. The logistical requirements of a course of action are based on the force units, latest arrival dates, and other scenario data. Capabilities are estimated by simulating the movement of personnel, equipment, and supplies through the theater's seaports, airports, and road/rail network to the destination. The system reports conclusions to the user, identifies real and potential bottlenecks, and recommends modifications to the course of action that are likely to improve its feasibility. LIST includes an expert system written in Prolog that select routes and seaports and move personnel, equipment, and supplies through a road/rail network. A user interacts with LIST through menus and series of map displays. The maps show relevant features and allow the user to access an object-oriented database. 7 refs., 6 figs.

41378 (DOE/EIA–0230) **National energy information system version 1.0 catalog of holdings.** Everett, C.G. USDOE Energy Information Administration, Washington, DC (USA); USDOE Energy Information Administration, Washington, DC (USA). Office of the National Energy Information System. Jun 1980. 120p. Sponsored by U.S. DOE Management & Administration. Order Number DE89014984/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report contains a description of Version 1.0 of the National Energy Information System (NEIS). When fully developed, NEIS will consist of: A collection of energy data organized in such a way as to be useful for analysis of energy issues. Metadata (i.e., data about the data) that document the characteristics and organization of all EIA data including the NEIS data, and provide ways of locating and accessing it. A set of procedures for gathering, updating, and disseminating NEIS data and metadata.

41379 (NEDOJ–8809) **Proceedings of parallel sessions for the 8th NEDO General Assembly.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). 16 Sep 1988. 539p. (In Japanese). Order Number DE89760510/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - Available from New Energy Development and Industrial Technology Organization, Tokyo, Japan.

The subcommittees consist of 6 groups which have been studying coal, solar, thermal, fuel/storage, alcohol/biomass, and coal resources technologies. The reports on the result of study by the Coal Subcommittee are concerned with brown coal liquefaction, bituminous coal liquefaction, development of hydrogen production utilizing coal, etc. The reports by the Solar Technology Subcommittee are on the photovoltaic power generation technology, development of large scale power geenration system, etc. The Geothermal Subcommittee reports on the investigation of geothermal energy and subjects related to geothermal technologies. The reports by the Fuel/Storage Technology Subcommittee include development of general technlogy for phosphoric acid fuel cell, research and development of molten carbonate fuel cell system, development of fuel alcohol technology, methanol upgrading type power generation technology, etc. The reports by the Coal Resources Subcommittee are on the prospecting in the Ensham Project, basic research for the development of coal resources, and study on coal renaissance.

41380 (PNL-SA–16290) **Barriers to effective information access: User perspectives.** McVeety, R.C. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8906128–2: Special Libraries Association meeting, New York, NY (USA), 10-15 Jun 1989). Order Number DE89014920/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Barriers to effective information access can be behavioral, procedural or technological. This report focuses on the user's perception of these barriers. The goals of this report are first, to review potential barriers; second, to stimulate thinking about addressing barriers in your own work place; and third, to propose areas of challenge and opportunity for special librarians in overcoming these barriers.

41381 (SV-UG–1989-1) **GPS for gas, positioning with satellites.** Haakansson, A. Swedish State Power Board, Vaellingby (Sweden). 1 Nov 1988. 97p. (In Swedish). Order Number DE89902439/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The goals for the project have been: to carry through a field test in connection with the 'Vaestgas'-project in southwestern part of Sweden for positioning control points in plane and in height; to compare GPS-technique with conventional measurements regarding accuracy, working time and costs; to demonstrate the GPS-technique for persons involved with surveying in the staff of 'Vattenfall' and especially; to control the positions of a couple of bench marks, where doubts have arousen about earlier results. The results of the project can be summarized as follows:* GPS-measurements are technically fit for positioning with an accuracy of 1 - 2 cm as regards horizontal control points, * GPS-measurements are today more economical than conventional measurements in networks with distances from 3 - 5 km and longer, * GPS-measurements are possible to carry out even under bad weather conditions, when conventional measurements are impossible to do, * GPS-measurements are suitable to use in larger regional projects, because the results can be given in one, uniform coordinate system, * GPS-measurements for accurate height positioning needs a more comprehensive support from earlier, accurately determined control points (due to the geoid-height-variations that can occur), * The GPS-measurements in the test area have shown weaknesses in earlier control surveys carried out with conventional methods. (With 18 refs.) (author).

9901 Management

Refer also to citation(s) 40342, 40765, 41398, 41408

41382 (IAE–4720/3) **Main trends in research and development works of nuclear centers in USA, UK, France, FRG and Japan. Pt. 3. Japan. Specific features in research and development organizing and tendencies in scientific directions of leading foreign nuclear research centres.** Ivanova, L.M.; Mironov, V.D.; Panin, V.I.; Sidorov, P.S.; Shkutov, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 35p. (In Russian). Order Number DE89633853/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Data on composition, structure and scientific trends of main nuclear centers in Japan are systematized. Peculiarities of research and development works organization and tendencies of scientific trends of main foreign nuclear centers are detected as result os analysis. 14 figs.; 1 tab.

41383 (INIS-mf–11493) **Annual report 1987-1988.** Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. 45p. Order Number DE89633854/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

For this thirtieth year of operation, the Institute's twenty constituent organisations were eighteen Australian universities, the Australian Nuclear Science and Technology Organisation (ANSTO) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Through 1987-88, AINSE's operations supported research and training in the nuclear field, assisted the application of

nuclear techniques in science, engineering and industrial technology, and assisted the universities and similar organisations in using the reactors, accelerators and other special facilities within the Lucas Heights Research Laboratories.

41384 (RISO-R–565) **Systems Analysis Department Annual progress report 1988.** Larsen, H.; Mackenzie, G.A. (eds.). Risoe National Lab., Roskilde (Denmark). Mar 1989. 30p. Order Number DE89902327/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1 - Risoe Libary, DK-4000 Roskilde.

The report describes the work of the systems Analysis Department at Risoe National Laboratory during 1988. The activities may be classified as energy systems analysis, risk and reliability analysis and environmental modelling. The report includes a list of staff members. (author).

9902 Mathematics and Computers

Refer also to citation(s) 39846, 39885, 39887, 39888, 39934, 39939, 39941, 39943, 40033, 40034, 40052, 40079, 40082, 40168, 40201, 40232, 40242, 40247, 40248, 40249, 40266, 40281, 40302, 40306, 40308, 40309, 40366, 40371, 40373, 40377, 40437, 40679, 40687, 40698, 40699, 40700, 40701, 40709, 40721, 40813, 40874, 41015, 41040, 41053, 41075, 41221, 41255, 41322, 41354, 41357, 41363, 41364, 41377

41385 (ANL–89/20) **A classification of lattice rules using the reciprocal lattice generator matrix.** Lyness, J.N.; Newman, W. Argonne National Lab., IL (USA). Jun 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE89014364/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The search for cost-effective lattice rules is a time-consuming and difficult process. After a brief overview of some of the lattice theory relevant to these rules, a new approach to this search is suggested. This approach is based on a classification of lattice rules using "the upper triangular lattice form" of the reciprocal lattice generator matrix. 14 refs., 1 tab.

41386 (ANL/MCS-TM–130) **LAPACK working note No. 10: Installing and testing the initial release of LAPACK Unix and non-Unix versions.** Anderson, E.; Dongarra, J. Argonne National Lab., IL (USA). Mathematics and Computer Science Div. May 1989. 38p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE89015124/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This working note describes how to install and test the initial release of LAPACK. LAPACK is intended to provide a uniform set of subroutines to solve the most common linear algebra problems and to run efficiently on a wide range of architectures. The routines presented at this time are intended not for general distribution, but only for initial testing. We expect the testing to reveal weaknesses in the design, and we plan to modify routines to correct any deficiencies. The instructions for installing, testing, and timing are designed for a person whose responsibility is the maintenance of a mathematical software library. This paper provides instructions for Unix users installing a tar tape, and contains instructions for non-Unix users. We assume the installer has experience in compiling and running Fortran programs and in creating object libraries. The installation process involves reading a tape, creating a library from the Fortran source, running the tests, and sending the results to Argonne. 6 refs.

41387 (CEA-CONF–9743) **Castem 2000: a modern approach of computerized structural analysis.** Verpeaux, P.; Millard, A.; Hoffmann, A.; Ebersolt, L. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 10p. (CONF-8811187–: Seminar on recent advances in design procedures for high temperature plant, Risley (UK), 8-9 Nov 1988). Order Number DE89903182/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Since the early beginning of the computerized structural analysis, many general purpose programs have been developed. Their complexity has increased rapidly and they became difficult to use and to maintain. The needs for an improved user's friendliness and the treatment of complex coupled problems have led to a modern tool: CASTEM 2000. It has profited by the general progress in computers technology and by a twenty years experience in large finite element codes. Its basic principles as well as examples of applications will be presented in this paper.

41388 (CEA-CONF–9780) **Languages for structural calculations.** Thomas, J.B.; Chambon, M.R. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 15p. (In French). (CONF-8805319–: 2. Symposium GRECO-GIS on structures calculation, Giens (France), 24-27 May 1988). Order Number DE89903291/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The differences between human and computing languages are recalled. It is argued that they are to some extent structured in antagonistic ways. Languages in structural calculation, in the past, present, and future, are considered. The contribution of artificial intelligence is stressed.

41389 (CEA-CONF–9781) **Modular code supervisor. Automatic generation of command language.** Dumas, M.; Thomas, J.B. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 14p. (In French). (CONF-8805319–: 2. Symposium GRECO-GIS on structures calculation, Giens (France), 24-27 May 1988). Order Number DE89903302/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

It is shown how, starting from a problem formulated by the user, to generate the adequate calculation procedure in the command code, and acquire the data necessary for the calculation while verifying their validity. Modular codes are used, because of their flexibility and wide utilisation. Modules are written in Fortran, and calculations are done in batches according to an algorithm written in the GIBIANE command language. The action plans are based on the STRIPS and WARPLAN families. Elementary representation of a module and special instructions are illustrated. Dynamic construction macro-actions, and acquisition of the specification (which allows users to express the goal of a program without indicating which algorithm is used to reach the goal) are illustrated. The final phase consists in translating the algorithm into the command language.

41390 (CONF-890866–1) **Numerical experiments with a boundary element technique for corners.** Gray, L.J. Oak Ridge National Lab., TN (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 11. boundary elements conference; Boston, MA (USA); 29-31 Aug 1989. Order Number DE89010839/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A method for handling regions with corners or discontinuous boundary data has been recently proposed by Mitra and Ingber (Boundary Elements IX, pp. 519-532). Using double nodes to represent the corner and an external collocation point to generate the necessary additional equation, this paper reported (for the most part successful) test results on a variety of two dimensional problems. In this paper, an exactly solvable Laplace equation problem, posed in a region with reentrant and non-reentrant edges, has been employed to study the behavior of this algorithm in three dimensions (boundary surface edges give rise to multiple corner points, thus making the problem more difficult). Experiments using several sets of external collocation points indicate that this technique is not a reliable procedure in three dimensions, yielding answers that are sensitive to the location of external nodes. 6 refs., 6 figs.

41391 (CONF-8906167–1) **Computing the Hough transform on an MIMD hypercube.** Bowyer, K.W.; Jones, J.P.; Lake, C.H. Oak Ridge National Lab., TN (USA). 1989. 11p. Sponsored by DOD;DOE/ER;DOE/NE;OGA. DOE Contract AC05-84OR21400. From 6. Scandanavian image analysis conference; Oulu (Finland); 19-22 Jun 1989. Order Number DE89013920/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The computational expense of Hough transforms has prompted researchers to investigate the feasibility of parallel implementations. Most such work to date has dealt with special- purpose architectures or with implementations for SIMD machines such as the MPP or GAPP. This report considers the problem of efficiently implementing Hough transforms on an MIMD hypercube architecture. Beginning with a general analysis of how the data structures might

be partitioned to allow a parallel computation, we formulate algorithm and data structure partitioning strategies appropriate to the architecture and then discuss modifications to optimize the performance for a particular hypercube system (the NCUBE). We also present the results of implementing and benchmarking Hough transforms on a 64-processor NCUBE. 22 refs., 6 figs., 1 tab.

41392 (DOE/ER/25057–1) **Third SIAM conference on applied linear algebra and short course on linear algebra in statistics.** Society for Industrial and Applied Mathematics, Philadelphia, PA (USA). 1988. 74p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER25057. (CONF-8805313–Absts.: 3. SIAM conference on applied linear algebra, Madison, WI (USA), 23-26 May 1988). Order Number DE89015443/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report contains abstracts on the following themes: Large Scale Computing and Numerical Methods; Inverse Eigenvalue Problems; Qualitative and Combinatorial Analysis of Matrices; Linear Systems and Control; Parallel Matrix Computations; Signal Processing; Optimization; Multivariate Statistics; Core Linear Algebra; and Iterative Methods for Solving Linear Systems. (LSP)

41393 (JINR-R–11-88-491) **Four-channel serial interface for SM-4 computers.** Ladygin, E.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 8p. (In Russian). Order Number DE89633849/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Prib. Tekh. Ehksp.

Interface for SM-4 and SM-1420 computers allows to connect four perideral devices with standard interface V24 is described. It provides possibility to choose exchange baud rate and data format for each channel. 5 refs.; 5 figs.; 5 tabs.; submitted to Prib. Tekh. Ehksp.

41394 (LA-UR–89-2125) **LaTEX memos and letters.** Sydoriak, S.J. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890893–1: Annual Tex users group, Stanford, CA (USA), 20-23 Aug 1989). Order Number DE89014224/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Letters and memos at Los Alamos National Laboratory (LANL) are formatted in accordance with rules established in the Laboratory's Office Procedures Manual. LaTEX style files were written to let people produce letters and memos without worrying about a complicated set of rules. Macro and template files are distributed through the Laboratory's Change Control system for use on VAX/UNIX, VAX/VMS, Sun, Apollo, and IBMPC. A testbed of several hundred test files is used to minimize bugs in the distributed versions. There is a choice of Computer Modern fonts or PostScript fonts. Memos and letters can be printed in Roman or typewriter typefaces. When called for, classification labels will be printed on every page. Headers on pages following the first page are compiled from information found on the first page. Letters can handle multiple addresses. Default options are provided where applicable, and error messages warn users about missing information fields. 2 refs., 6 figs.

41395 (ORNL/TM–11089) **Stabilized Gaussian reduction of an arbitrary matrix to tridiagonal form.** Geist, G.A.; Lu, A.; Wachspress, E.L. Oak Ridge National Lab., TN (USA). Jun 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014347/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report presents several ideas for improving the stability of Gaussian reduction of an arbitrary real matrix to tridiagonal form. First, we analyze conditions under which reduction algorithms break down or become unstable. Second, we discuss how methods of threshold pivoting decrease the probability of these conditions occurring. Finally, we present new methods for recovering from breakdown when it does occur. The class of matrices that can be successfully reduced is significantly broadened by these new recovery algorithms. 16 refs., 4 figs.

41396 (PNL-SA–16682) **Framework for distributed artificial neural system simulation.** Barga, R.S.; Melton, R.B. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8906172–1: International joint conference on neural networks, Washington, DC (USA), 19-22 Jun 1989). Order Number DE89014919/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this paper, we describe a distributed artificial neural system (ANS) simulation environment for research on large-scale ANS networks. The ANSkit, as the environment is called, allows local graphics workstations to utilize ANS simulation engines implemented on remote supercomputers and to interactively display the results of the simulation. The ANSkit design uses extensive data compression and standard network protocols to permit its use over wide area, as well as local area networks. The ANSkit demonstrates an easily used, simulation visualization capability for ANS in a heterogeneous, distributed computing environment. Further, ANSkit demonstrates how remote supercomputing resources can provide a cost-effective tool for ANS research. 8 refs., 3 figs.

41397 (SAND–88-2427C) **A low-cost hypercube load-balance algorithm.** Dragon, K.M.; Gustafson, J.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-890372–13: 4. hypercube, concurrent computers and applications, Monterey, CA (USA), 6-8 Mar 1989). Order Number DE89015739/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have developed a divide-and-conquer approach to dynamic load balancing for a 1024-processor hypercube that requires only $O(1)$ additional storage and $O((\log_2 P)^2)$ additional operations. The balancing is done with global information rather than the nearest-neighbor information used in less effective techniques. Unlike previous global load balancers, the balancing is distributed over the ensemble rather than performed by a single processor. The algorithm has been tested using particle simulation, and is quite fast. The technique appears applicable to the efficient parallelization of Particle-In-Cell methods, finite difference and finite element methods with adaptive meshes, molecular dynamics calculations and other timestepping applications where dynamic load balancing is required.

41398 (SAND–89-1308C) **Security command, control, and display systems development status.** Waddoups, I.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890889–1: 5. annual symposium on technical displays on physical and electronic security, Philadelphia, PA (USA), 15-17 Aug 1989). Order Number DE89012677/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories has developed a variety of command, control, and display systems for a broad spectrum of users. This paper briefly describes the latest systems developed for the Department of Energy (DOE), the Department of Defense (DOD), and the Department of State (DOS) applications. Applications covered vary from relatively small facilities to large complex sites. 3 refs., 6 figs.

41399 (SAND–89-1715) **An integrated network management tool.** Miller, M.C. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 34p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC04-76DP00789. Order Number DE89014353/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report describes an integrated network management tool designed to minimize the time and effort required to diagnose and resolve data communications problems at Sandia National Laboratories, Albuquerque. A workstation is utilized to consolidate several functions necessary for diagnosing these problems, thus reducing the amount of hardware required for troubleshooting. Functions include managing data PBX and PACX switches, accessing circuit database information on a VAX, and monitoring alarms. In addition to consolidating functions, enhanced capability is provided for simplifying the complex procedure of troubleshooting data PBX problems. The first two sections of this report give an introduction and overview of the network management applications and the last section provides details of operation. 17 figs.

41400 (UCID–21689) **Storage architectures and issues.** Coleman, S. Lawrence Livermore National Lab., CA (USA). 23 Jun 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014324/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

There is a growing trend among supercomputer sites toward distributed systems that provide "seamless" user environments. To support these heterogeneous environments, archival storage systems are becoming distributed, allowing users to access files transparently from different machines no matter where the files were originally created or where they are stored. In this paper, I will describe storage systems architectures in several supercomputer sites and some of the issues that should be considered in designing storage systems to support seamless computing. 11 refs., 4 figs.

41401 (UCRL–101085) **Run-time support for parallel functional programming on shared memory multiprocessors.** Ching-Cheng, Lee; Fatmi, H.A. Lawrence Livermore National Lab., CA (USA). May 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890892–1: 12. international congress on cybernetics, Namur (Belgium), 21-25 Aug 1989). Order Number DE89013790/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The use of functional languages for parallel computing has been proposed for many years. Many functional languages were developed along with the design of new architectures such as data flow and reduction machines. In this paper, we present a general model of a run-time system for a parallel functional language called SISAL to be executed on shared-memory multiprocessors. The implementation of this run-time system is examined on two radically different architectures; i.e., a 32-way (symmetrical) Vax Research Multiprocessor M31 and a 4-way Cray X-MP system. In order to properly evaluate the effectiveness of SISAL on shared-memory multiprocessors, we suggest exploring an interactive visual control mechanism that dynamically show run-time behavior in future research. 15 refs., 3 figs., 1 tab.

41402 (UCRL–101209) **Numerical methods for differential-algebraic equations: Current status and future directions.** Petzold, L.R. Lawrence Livermore National Lab., CA (USA). 20 Jun 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8907106–2: Institute of Mathematics and its applications: conference on computational ordinary differential equations, London (UK), 3-7 Jul 1989). Order Number DE89015116/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many physical systems are naturally described as systems of differential-algebraic equations (DAE's). These types of systems occur in the modeling of electrical networks, flow of incompressible fluids, control, mechanical systems subject to constraints, and in many other applications. This class of problems include systems which are in many ways quite different from ODE's. In this paper we outline some of the recent developments in the numerical solution of DAE systems, including problem structure and formulation, convergence and order results for multistep and Runge-Kutta methods, and general purpose codes. Finally, we indicate some directions for future progress. 36 refs.

41403 Distributed scientific video movie making. Johnston, W.E. (Advanced Development Group, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)); Hall, D.E.; Huang, J.; Rible, M.; Robertson, D. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

The authors describe a versatile, low cost, video movie making system for generating and displaying scientific graphics from remote supercomputers. The system makes video movies by single frame animation from the output of time dependent, numerical simulations typically done on supercomputers. The system uses extensive data compression to permit its use over wide area, as well as local area networks. The system demonstrates an easily used, elementary visualization capability for time dependent data in a heterogeneous, distributed computing environment.

41404 Cedar Fortran and other vector and parallel Fortran dialects. Guzzi, M.D. (Univ. of Illinois at Urbana-Champaign, Center for Supercomputing Research and Development, 305 Talbot Lab., 104 S. Wright Street, Urbana, IL (US)); Padua, D.A.; Hoeflinger, J.P.; Lawrie, D.H. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

The introduction of vector processors and multiprocessors punctuate the most dramatic changes in Fortran and its dialects. The emerging generation of supercomputers utilize both vector processing and multiprocessing simultaneously. The challenge is to provide language constructs and software tools that allow the programmer to easily exploit the capabilities of the machine. This paper outlines the development of vector and multiprocessor language constructs in Fortran. The significant architectures, their languages, and optimizers are described. The paper concludes with a description of Cedar Fortran, the language for the Cedar Multiprocessor under development at the University of Illinois, Urbana-Champaign. Cedar is a hierarchical, shared-memory, vector multiprocessor.

41405 Compiling issues for supercomputers. Girkar, M. (Center for Supercomputing Research and Development, Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)); Polychronopoulos, C. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

Accurate and fast methods for computing data dependence are vital to the efficiency of vectorizing and parallelizing compilers. Program transformations employed by these compilers are effective only if dependences are computed as accurately as possible. In this paper the authors consider two issues for supercomputer compilers. First, they discuss in detail exact and inexact tests for computing data dependences and focus on the linearization scheme. They then discuss a program transformation called loop spreading which allows them to execute in parallel adjacent loops with interloop dependences.

41406 Design and implementation of a supercomputer frame buffer system. Fowler, J.D. Jr. (Los Alamos National Lab., Los Alamos, NM (US)); McGowen, M. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

A 512 by 512 pixel by 8 bits per pixel frame buffer has been designed, constructed, and installed on a 48 Mbit/s I/O channel of a Cray X-MP 4/16 supercomputer. This project was undertaken to test whether such a system would be useful and, if so, how it would be used. Supporting software provides the ability to convert vector graphics description files into raster format, to show raster movies interactively, and to show vector files by real-time conversion from vector to raster formats. The authors have shown that real-time animations in an interactive supercomputer environment are feasible and useful with this system.

41407 A scientific visualization workbench. Phillips, R.L. (Los Alamos National Lab., P.O. Box 1663, MS B-272, Los Alamos, NM (US)). pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

A system for visualization of data from supercomputer simulations has been developed for use by scientists and engineers at Los Alamos National Laboratory. The scientific visualization workbench, as the system is called, is based on an industry standard workstation (a Sun 3/160C), the NeWS window system, and a video/graphics add-in card, which is supported by NeWS. Also involved is a frame buffer attached to a 48-Mbit/s Cray channel and a video link from the frame buffer to the Sun workstation. Computation and graphics preparation are performed on the Cray under the control of a NeWS client program. Images are rasterized and sent to the workstation at the rate of 25 frame/s. The workbench permits the scientist to converse with applications running on a Cray but still retain the convenience and flexibility of a personal workstation environment.

9903 Information Handling

41408 (CONF-8905176–2) **Designing a user-system interface.** Pfuderer, H.A.; Miller, K.C. Oak Ridge National Lab., TN

(USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From ASIS mid-year meeting; San Diego, CA (USA); 21-25 May 1989. Order Number DE89014082/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our team at the Oak Ridge National Laboratory (ORNL) has been successful in guiding managers of government organizations in planning and implementing successful strategic information systems. The essence of the ORNL methodology is to provide users at all levels in the organization many opportunities to participate in systems development. This user involvement included: incorporating their own critical success factors into the planning process; defining the business objectives, processes, and needed systems implementation in a team approach; and providing down-to-earth, usability feedback in prototyping the most strategic systems. 2 figs.

41409 (SAND–89-7100) **Users' guide to SPEEDI: The Sandia partitioned engineering environmental database implementation: Topical report RSI-0330.** Kephart, E.M.; Haskell, K.H.; von Laven, G.M. RE/SPEC, Inc., Albuquerque, NM (USA). Jul 1989. 51p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE89013998/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report is an overview of the general use of the Sandia Partitioned Engineering Environmental Database Implementation, or SPEEDI. This software implements the evaluation and design which are documented in earlier reports. We briefly summarize some of the discussion and notation used in those reports for the convenience of the reader. Sandia currently maintains a large Environmental Databank consisting of data represented in a variety of formats. It was desired to convert from a hard copy system to a digitized system. A two-level system was proposed and implemented. The top level consists of a stable, read-only environment for engineers seeking information from the Environmental Databank. The lower level, the Analysis Databank, is an organized and automated work space to be used by analysts who require read-write access to large quantities of data. As these data are processed and reviewed, some may be selected for permanent retention in the top level. At this point, Quality Assurance (QA) restrictions may be applied. 9 refs.

9905 Civilian Defense

Refer also to citation(s) 40854

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4-1989	14:40318	NTIS (US Sales Only), PC A05/MF A01		DE89902423/JAW	MF-000
BFR-R–					
10-1989	14:40387	NTIS (US Sales Only), PC A03/MF A01		DE89902428/JAW	MF-000
12-1989	14:40425	NTIS (US Sales Only), PC A04/MF A01		DE89902429/JAW	MF-000
14-1989	14:40388	NTIS (US Sales Only), PC A03/MF A01		DE89902430/JAW	MF-000
16-1989	14:40389	NTIS (US Sales Only), PC A03/MF A01		DE89902431/JAW	MF-000

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17-1989	14:40821	NTIS (US Sales Only), PC A07/MF A01		DE89902432/JAW	MF-000
18-1989	14:40390	NTIS (US Sales Only), PC A05/MF A01		DE89902470/JAW	MF-000
2-1989	14:40384	NTIS (US Sales Only), PC A03/MF A01		DE89902424/JAW	MF-000
24-1989	14:40147	NTIS (US Sales Only), PC A07/MF A01		DE89902471/JAW	MF-000
26-1989	14:40148	NTIS (US Sales Only), PC A06/MF A01		DE89902472/JAW	MF-000
4-1989	14:40385	NTIS (US Sales Only), PC A05/MF A01		DE89902425/JAW	MF-000
6-1989	14:40153	NTIS (US Sales Only), PC A03/MF A01		DE89902426/JAW	MF-000
7-1989	14:40386	NTIS (US Sales Only), PC A08/MF A01		DE89902427/JAW	MF-000
BHRA-RR–					
2376	14:39844				ND-000
BMU–					
1988-195	14:40882	GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.)			ND-000
BNL–					
42010	14:40773	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015105/JAW	MF-414
42011	14:40774	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015103/JAW	MF-414
42044	14:40755	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015110/JAW	MF-414
42650	14:41155	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015113/JAW	MF-414
42834	14:40733	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014040/JAW	MF-414
42853	14:41156	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015106/JAW	MF-414
42854	14:41157	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015157/JAW	MF-410
42856	14:41079	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015109/JAW	MF-414
42907	14:40822	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015107/JAW	MF-404
42932	14:41158	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015097/JAW	MF-414
42937	14:40744	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015075/JAW	MF-414
42939	14:40745	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015111/JAW	MF-414
43009	14:40937	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015102/JAW	MF-408
43032	14:40440	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015100/JAW	MF-404
43035	14:40938	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015098/JAW	MF-408
BNL-NCS–					
42989	14:41212	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015108/JAW	MF-413
BNL-NUREG–					
42533	14:40265	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011252/JAW	MF-000
42676	14:40266	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012670/JAW	MF-000
42677	14:40267	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012671/JAW	MF-000
52206	14:40920	*See* NUREG/CR–5387			
BONN-AM–					
89-01	14:41321	NTIS (US Sales Only), PC A02/MF A01		DE89795128/JAW	MF-000
BONN-IR–					
89-05	14:41080	NTIS (US Sales Only), PC A06/MF A01		DE89795142/JAW	MF-000
BONN-ME–					
89-02	14:40778	Bonn Univ. (Germany, F.R.). Physikalisches Inst.			ND-000
89-03	14:41159	NTIS (US Sales Only), PC A03/MF A01		DE89795105/JAW	MF-000
89-04	14:41160	NTIS (US Sales Only), PC A03/MF A01		DE89795106/JAW	MF-000
BR–					
82(11.96)	14:40911	*See* TR-EL–82-4			
CE–					
02692	14:40928	*See* ERCB-D–89-2			
CEA-CONF–					
9743	14:41387	NTIS (US Sales Only), PC A02/MF A01		DE89903182/JAW	MF-000
9745	14:40709	NTIS (US Sales Only), PC A03/MF A01		DE89903266/JAW	MF-000
9752	14:40441	NTIS (US Sales Only), PC A03/MF A01		DE89903181/JAW	MF-000
9780	14:41388	NTIS (US Sales Only), PC A03/MF A01		DE89903291/JAW	MF-000
9781	14:41389	NTIS (US Sales Only), PC A03/MF A01		DE89903302/JAW	MF-000
9788	14:40442	NTIS (US Sales Only), PC A02/MF A01		DE89903281/JAW	MF-000
CEA-DAS–					
532e	14:41019	NTIS (US Sales Only), PC A02/MF A01			MF-000
563	14:39926	NTIS (US Sales Only), PC A02/MF A01		DE89903264/JAW	MF-000
575	14:40685	NTIS (US Sales Only), PC A02/MF A01		DE89903180/JAW	MF-000
576	14:40686	NTIS (US Sales Only), PC A03/MF A01		DE89903188/JAW	MF-000
577	14:41015	NTIS (US Sales Only), PC A02/MF A01		DE89903187/JAW	MF-000
588	14:40268	NTIS (US Sales Only), PC A02/MF A01		DE89903193/JAW	MF-000
589	14:40269	NTIS (US Sales Only), PC A03/MF A01		DE89903138/JAW	MF-000
CEA-DPhPE–					
89-06	14:41335	NTIS (US Sales Only), PC A02/MF A01		DE89903186/JAW	MF-000
CEA-N–					
2586	14:41040	NTIS (US Sales Only), PC A03/MF A01		DE89903185/JAW	MF-000
2604	14:41357	NTIS (US Sales Only), PC A03/MF A01		DE89903173/JAW	MF-000
CEA-R–					
5478	14:39913	NTIS (US Sales Only), PC A07/MF A01		DE89903267/JAW	MF-000
5480	14:40486	NTIS (US Sales Only), PC A08/MF A01		DE89903268/JAW	MF-000

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CERN–					
89-04	14:40731	NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS		DE89620100/JAW	MF-000
89-05	14:40732	NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS		DE89633417/JAW	MF-000
CONF-8504342–		(20. winter school on physics; Zakopane (Poland); 13-26 Apr 1985)			
	14:41217	*See* INP–1302/PS			
CONF-8509462–		(IAEA co-ordinated research program on the examination and documentation methodology for water reactor fuel (ED-WARF); Vienna (Austria); 9-11 Sep 1985)			
	14:40239	*See* AECL–8904			
CONF-8610330–		(IEA workshop on pressurized fluidized bed combustion; Stockholm (Sweden); 22-24 Oct 1986)			
	14:39881	*See* STEV–1988-R11			
CONF-8611146–		(Commission of European Communities symposium on CO_2 and other greenhouse: climate and associated impacts; Brussels (Belgium); 3-5 Nov 1986)			
	14:39860	*See* EUR–11797			
CONF-8612176–		(National seminar on mathematical methods in field theory; Amsterdam (Netherlands); 12 Dec 1986)			
	14:41209	*See* NIKHEF-H–89-4			
CONF-8704383–		(American Nuclear Society (ANS) topical meeting; Kennewick, WA (USA); Apr 1987)			
1	14:40250	*See* HEDL-SA–3712			
CONF-8707208–		(U.S. Particle Accelerator School: physics of particle accelerators; Batavia, IL (USA); 20 Jul - 14 aug 1987)			
7	14:40733	*See* BNL–42834			
CONF-870820–		(PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich (Switzerland); 31 Aug - 4 sep 1987)			
	14:40685	*See* CEA-DAS–575			
CONF-8709172–		(8. international conference on textures of materials (ICOTOM-8); Santa Fe, NM (USA); 20-25 Sep 1987)			
	14:40450	*See* GKSS–88/E/63			
CONF-8709450–		(ANS/ENS international conference on fast breeder system; Kennewick, WA (USA); Sep 1987)			
1	14:40223	*See* HEDL-SA–3626			
CONF-8709451–		(Symposium on strain measurement technique: practical applications under specific boundary conditions for enhancing plant safety and availability; Koeln (Germany, F.R.); 24 Sep 1987)			
	14:40826	*See* INIS-mf–11985			
CONF-8711240–		(Australian joint artificial intelligence conference; Sydney (Australia); 2-4 Nov 1987)			
	14:40579	*See* INIS-mf–11495			
CONF-8801167–		(Status report of Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN) of Kernforschungszentrum Karlsruhe GmbH; Karlsruhe (Germany, F.R.); 29-30 Jan 1988)			
	14:39916	*See* PtUB–21			
CONF-8802102–		(Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT); Upton, NY (USA); 1-2 Feb 1988)			
5	14:40938	*See* BNL–43035			
CONF-880317–		(ASM symposium on engineered materials for advanced friction and applications; Gaithersburg, MD (USA); 1-3 Mar 1988)			
	14:40438				
CONF-8804117–		(Adhesion in solids; Reno, NV (USA); 5-7 Apr 1988)			
	14:40502				
CONF-8804283–		(3. Korea Atomic Industrial Forum/Korea Nuclear Society joint annual conference; Seoul (Republic of Korea); 18-20 Apr 1988)			
	14:40261	*See* AECL–9720			

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CONF-8805305–		(CAS course on superconductivity in particle accelerators; Hamburg (Germany, F.R.); 30 May - 3 jun 1988)			
	14:40731	*See* CERN–89-04			
CONF-8805309–		(18. All-Union conference on charged particle interaction with crystals; Moscow (USSR); 30 May - 1 jun 1988)			
	14:41271	*See* INIS-SU–98			
CONF-8805312–		(2. national outdoor action conference on aquifer restoration, groundwater monitoring and geophysical methods; Las Vegas, NV (USA); 23-26 May 1988)			
1	14:40916	*See* WHC-SA–0174			
CONF-8805313–		(3. SIAM conference on applied linear algebra; Madison, WI (USA); 23-26 May 1988)			
Absts.	14:41392	*See* DOE/ER/25057–1			
CONF-8805314–		(CEC contractors' meeting on coal-water mixtures; Brussels (Belgium); 26 May 1988)			
	14:39877	*See* EUR–11846			
CONF-8805319–		(2. Symposium GRECO-GIS on structures calculation; Giens (France); 24-27 May 1988)			
	14:41388	*See* CEA-CONF–9780			
	14:41389	*See* CEA-CONF–9781			
CONF-8806105–		(17. international colloquium on group theoretical methods in physics; St. Adele (Canada); 27 Jun - 2 jul 1988)			
	14:41030	*See* IFUSP-P–743			
CONF-8806117–		(3. international conference on nucleus nucleus collisions; Saint-Malo (France); 6-11 Jun 1988)			
	14:41222	*See* GANIL-P–88-07			
CONF-8806225–		(9. international seminar on high energy physics problems relativistic nuclear physics and quantum chromodynamics; Dubna (USSR); 14-19 Jun 1988)			
	14:41144	*See* IPNO-DRE–88-23			
CONF-8806236–		(1. European workshop on hadronic physics in the 1990's with multi-GeV electrons; Seillac (France); 27 Jun - 1 jul 1988)			
	14:41145	*See* IPNO-DRE–88-35			
CONF-8806243–		(DPF summer study: Snowmass '88: high energy physics in the 1990s; Snowmass, CO (USA); 27 Jun - 15 jul 1988)			
43	14:41027	*See* DOE/ER/03130–49C			
44	14:41155	*See* BNL–42650			
CONF-8806348–		(6. seminar on industrial safety; Curitiba (Brazil); 21-24 Jun 1988)			
	14:40091	*See* INIS-BR–1551			
CONF-8806392–		(IAEA technical committee meeting on burnup determination of water reactor fuel; Karlsruhe (Germany, F.R.); 13-16 Jun 1988)			
Summs.	14:40202	*See* IWGFPT–31			
CONF-8806393–		(CEC contractors' meeting on flue gas and fly ash; Brussels (Belgium); 16 Jun 1988)			
	14:39851	*See* EUR–11845			
CONF-8806395–		(17. International colloquium on group theoretical methods in physics; Sainte-Adele, CA (USA); 27 Jun - 2 jul 1988)			
	14:41208	*See* LYCEN–88-02			
	14:41331	*See* LYCEN–88-29			
CONF-880695–		(1. European Particle Accelerator Conference (EPAC-1); Rome (Italy); 7-11 Jun 1988)			
	14:40734	*See* CRN-VIV–55/1			
CONF-8807179–		(Ice-structure interaction workshop; Calgary (Canada); 27 Jul 1988)			
	14:40730	*See* MU/CCORE–1988			
CONF-880766–		(5. international conference on clustering aspects in nuclear and subnuclear systems; Kyoto (Japan); 25-29 Jul 1988)			
	14:41225	*See* CRN-PN–88-23			

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CONF-880795–		(International symposium on heavy ion physics and nuclear astrophysical problems; Tokyo (Japan); 21-23 Jul 1988)			
	14:41215	*See* GANIL-P–88-13			
CONF-880802–		(22. international symposium on combustion; Seattle, WA (USA); 14-19 Aug 1988)			
	14:39868	The Combustion Institute, 5001 Baum Blvd., Pittsburgh, PA 15213			ND-103
11	14:40728	*See* DOE/CE/90213–T4			
CONF-8808115–		(11. international mass spectrometry conference; Bordeaux (France); 29 Aug - 2 sep 1988)			
	14:40793	*See* IPNO-DRE–88-32			
CONF-8808126–		(37. annual applications of analysis x-ray conference; Steamboat Springs, CO (USA); 1-5 Aug 1988)			
2	14:40695	*See* LBL–27103			
CONF-8808202–		(19. annual meeting of the European Society of Nuclear Methods in Agriculture; Vienna (Austria); 29 Aug - 2 sep 1988)			
	14:40960	*See* OEFZS–4489			
CONF-8808254–		(Workshop on premixed turbulent combustion; Berkeley, CA (USA); 22-23 Aug 1988)			
Summ.	14:40683	*See* LBL–27183			
CONF-880865–		(Gordon conference on atomic and molecular interactions; Plymouth, NH (USA); 1-5 Aug 1988)			
	14:40738	*See* IKDA–88-14			
CONF-880905–		(3. international conference on stability and handling of liquid fuels; London (UK); 13-16 Sep 1988)			
Vol.1	14:39892	The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR, United Kingdom			ND-125
Vol.2	14:39896	The Institute of Petroleum, 61 New Cavendish St., London W1M 8AR, United Kingdom			ND-108
CONF-8809228–		(American Chemical Society Division of Fuel Chemistry meeting; Los Angeles, CA (USA); 25-30 Sep 1988)			
	14:39840				
	14:39841				
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	14:39843				
CONF-8809269–		(Bioprocessing of coal; Los Angeles, CA (USA); 25-30 Sep 1988)			
	14:39816				
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CONF-8809271–		(Surface chemistry of coal; Los Angeles, CA (USA); 25-30 Sep 1988)			
	14:39791				
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CONF-8809272–		(Coal combustion and soot formation; Los Angeles, CA (USA); 25-30 Sep 1988)			
	14:39897				
CONF-8809281–		(4. topical meeting on short wavelength coherent radiation: generation and applications; North Falmouth, MA (USA); 26-29 Sep 1988)			
	14:40703	Optical Society of America, 1816 Jefferson Place, NW, Washington, DC 20036			ND-406

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CONF-8809372–		(2. Congress on NDT for Latin America and the Caribbean; Lima (Peru); 25-28 Sep 1988)			
	14:40715	*See* INIS-mf–11460			
CONF-8809374–		(Israel Health Physics Society annual meeting 1988; Herzliya (Israel); 5-6 Sep 1988)			
	14:40060	*See* INIS-mf–11502			
CONF-8809376–		(CAS CERN Accelerator School: 3. general accelerator physics course; Salamanca (Spain); 19-30 Sep 1988)			
	14:40732	*See* CERN–89-05			
CONF-8809377–		(7. European conference on fracture (ECF); Budapest (Hungary); 19-24 Sep 1988)			
	14:40442	*See* CEA-CONF–9788			
CONF-8810135–		(Switched-power workshop; 4. workshop on pulse power techniques for future accelerators; Shelter Island, NY (USA); 16-21 Oct 1988; 4-9 mar 1989)			
6	14:40770	*See* SLAC-PUB–4858			
CONF-881014–		(International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety; Avignon (France); 2-7 Oct 1988)			
	14:41019	*See* CEA-DAS–532e			
CONF-8810261–		(International workshop on nuclear dynamics at medium and high energies; Bad Honnef (Germany, F.R.); 10-14 Oct 1988)			
	14:41216	*See* GSI–89-34(prepr.)			
CONF-8810299–		(Interacting electrons in reduced dimensions; Torino (Italy); 3-7 Oct 1988)			
4	14:41314	*See* LA-UR–89-2520			
CONF-881031–		(8. topical meeting on technology of fusion energy; Salt Lake City, UT (USA); 9-13 Oct 1988)			
71	14:41370	*See* PNL-SA–16217			
CONF-8810356–		(3. joint US-Cern accelerator school on particle accelerators: frontiers of particle beams, observations, diagnosis, and correction; Capri (Italy); 20-26 Oct 1988)			
3	14:40745	*See* BNL–42939			
CONF-8810408–		(GAMM-Workshop; Marseille (France); 12-14 Oct 1988)			
	14:40709	*See* CEA-CONF–9745			
CONF-881103–		(IEEE nuclear science symposium; Orlando, FL (USA); 9-11 Nov 1988)			
65	14:40786	*See* FNAL-TM–1591			
CONF-8811187–		(Seminar on recent advances in design procedures for high temperature plant; Risley (UK); 8-9 Nov 1988)			
	14:40441	*See* CEA-CONF–9752			
	14:41387	*See* CEA-CONF–9743			
CONF-8811218–		(9. annual EPRI/NDE information meeting; Charlotte, NC (USA); 15-16 Nov 1988)			
	14:40234	*See* EPRI-NP–6075-SR			
CONF-8811240–		(Environmental impact of operation of uranium industry and of nuclear power plants; Prague (Czechoslovakia); 10 Nov 1988)			
	14:40255	*See* INIS-mf–11482			
CONF-8811241–		(Fuel oil utilization workshop; New Orleans, LA (USA); 16-17 Nov 1988)			
	14:39894	*See* EPRI-GS–6459			
CONF-8811246–		(14. AINSE radiation chemistry conference; Lucas Heights (Australia); 9-11 Nov 1988)			
	14:40669	*See* INIS-mf–11494			
CONF-881212–		(Particle astrophysics workshop; Berkeley, CA (USA); 8-10 Dec 1988)			
2	14:41032	*See* LBL–26589			
CONF-881299–		(IAEA Technical Committee; Vienne (Austria); 5-9 Dec 1988)			
	14:39926	*See* CEA-DAS–563			
CONF-8901115–		(Topical conference on electronuclear physics with internal targets; Stanford, CA (USA); 9-12 Jan 1989)			
5	14:41151	*See* SLAC-PUB–5013			

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CONF-8901127–		(Workshop on high energy physics phenomenology; Bombay (India); 2-15 Jan 1989)			
2	14:41157	*See* BNL–42854			
3	14:41156	*See* BNL–42853			
CONF-8901131–		(Gell-Mann festschrift; Pasadena, CA (USA); 26-29 Jan 1989)			
1	14:41191	*See* LA-UR–89-1466			
CONF-8901134–		(Project summary presentation for Environmental Protection Agency and Washington State Department of Ecology; Seattle, WA (USA); 12 Jan 1989)			
1	14:39980	*See* PNL-SA–16553			
CONF-8901137–		(Symposium on the Pacific coal flow cooperation; Tokyo (Japan); 25 Jan 1989)			
	14:40866				
CONF-890161–		(17. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg (Austria); 15-19 Jan 1989)			
	14:41245	*See* INIS-mf–11992			
CONF-890197–		(Advanced accelerator concepts workshop; Lake Arrowhead, CA (USA); 9-13 Jan 1989)			
11	14:40744	*See* BNL–42937			
CONF-890203–		(IAEA international symposium on fire protection and fire fighting at nuclear installations; Vienna (Austria); 27 Feb - 3 mar 1989)			
	14:40269	*See* CEA-DAS–589			
	14:40686	*See* CEA-DAS–576			
	14:41015	*See* CEA-DAS–577			
CONF-8902110–		(2. international symposium on the 4th family of quarks and leptons; Santa Monica, CA (USA); 23-25 Feb 1989)			
3	14:41150	*See* SLAC-PUB–4990			
CONF-8902125–		(2. regional workshop on integrated monitoring; Burlington, VT (USA); 6-8 Feb 1989)			
1	14:40913	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015700/JAW	MF-402
CONF-890231–		(5. international wire chamber conference; Vienna (Austria); 13-17 Feb 1989)			
	14:40778	*See* BONN-ME–89-02			
8	14:40820	*See* SLAC-PUB–4875			
9	14:40819	*See* SLAC-PUB–4795			
CONF-890270–		(International industrial symposium on the super collider; New Orleans, LA (USA); 8-10 Feb 1989)			
21	14:40755	*See* BNL–42044			
CONF-890299–		(AHF accelerator design workshop; Los Alamos, NM (USA); 20-25 Feb 1989)			
15	14:40737	*See* FNAL-TM–1598			
CONF-8903112–		(Waste management '89; Tucson, AZ (USA); 1 Mar 1989)			
4	14:40696	*See* PNL-SA–16233			
CONF-8903129–		(7. Pacific basin conference; San Diego, CA (USA); 4-8 Mar 1989)			
1	14:40218	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013179/JAW	MF-530
CONF-8903132–		(24. Rencontres de Moriond: electroweak interactions and unified theories; Les Arcs (France); 5-12 Mar 1989)			
9	14:40741	*See* SLAC-PUB–5010			
CONF-8903143–		(24. Recontres de Moriond: new results in hadronic interactions; Les Arcs (France); 12-18 Mar 1989)			
2	14:41158	*See* BNL–42932			
3	14:41079	*See* BNL–42856			
CONF-8903144–		(Advanced hadron workshop; Los Alamos, NM (USA); Mar 1989)			
1	14:40749	*See* LA-UR–89-2140			
CONF-8903146–		(Switched-power workshop; 4. workshop on pulse power techniques for future accelerators; Shelter Island, NY (USA); 16-21 Oct 1988; 4-9 mar 1989)			
1	14:40770	*See* SLAC-PUB–4858			
CONF-8903147–		(Artificial intelligence applications for military logistics symposium; Williamsburg, VA (USA); 21-28 Mar 1989)			
1	14:41377	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015698/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8903149–		(Trends in theoretical physics colloquia series; Minneapolis, MN (USA); 29 Mar 1989)			
1	14:41185	*See* LBL–27288			
CONF-8903150–		(Workshop on neutron beam design, development and performance for neutron capture therapy; Cambridge, MA (USA); 30-31 Mar 1989)			
1	14:40937	*See* BNL–43009			
CONF-890335–		(13. particle accelerator conference; Chicago, IL (USA); 20-23 Mar 1989)			
222	14:40750	*See* SLAC-PUB–4886			
232	14:40773	*See* BNL–42010			
233	14:40774	*See* BNL–42011			
234	14:40746	*See* FNAL/C–89/87			
235	14:40759	*See* FNAL/C–89/92			
236	14:40761	*See* FNAL-TM–1577			
240	14:40742	*See* UCRL–99579			
CONF-890372–		(4. hypercube, concurrent computers and applications; Monterey, CA (USA); 6-8 Mar 1989)			
13	14:41397	*See* SAND–88-2427C			
CONF-890379–		(Workshop on calorimetry for the SSC; Tuscaloosa, AL (USA); 13-17 Mar 1989)			
11	14:40779	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015716/JAW	MF-414
12	14:40802	*See* LBL–27328			
CONF-890388–		(4. European Physical Society (EPS) seminar on international research facilities; Zagreb (Yugoslavia); 17-19 Mar 1989)			
	14:41367	*See* GSI–89-41(prepr.)			
CONF-890405–		(PSA '89: international topical meeting on probability, reliability and safety assessment; Pittsburgh, PA (USA); 2-7 Apr 1989)			
	14:40268	*See* CEA-DAS–588			
CONF-890408–		(Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM (USA); 9-13 Apr 1989)			
15	14:41255	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015901/JAW	MF-405
CONF-8904169–		(Symposium on the fundamentals of gasification; Dallas, TX (USA); 9-14 Apr 1989)			
	14:39809				
	14:39810				
	14:39811				
	14:39812				
	14:39813				
	14:39814				
	14:39815				
CONF-8904214–		(2. international symposium on aneutronic power; Washington, DC (USA); 28-29 Apr 1989)			
1	14:41336	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015059/JAW	MF-421
CONF-8904226–		(12. international workshop on weak interactions and neutrinos; Ginosar (Israel); 9-14 Apr 1989)			
5	14:40740	*See* SLAC-PUB–4996			
CONF-890423–		(CLEO '89: conference on lasers and electro optics; Baltimore, MD (USA); 24-28 Apr 1989)			
12-Rev.2	14:41375	*See* UCRL–99316-Rev.2			
CONF-8904248–		(American Ceramic Society conference; Pittsburgh, PA (USA); 26-30 Apr 1989)			
1	14:39912	*See* HEDL-SA–3690			
CONF-8904249–		(U.S.-Japan Energy Policy Consultations meeting; Mt. Fuji (Japan); 9-11 Apr 1989)			
	14:40327	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013969/JAW	MF-900
CONF-8904251–		(Workshop on the length of time materials; Oxford (UK); 11-13 Apr 1989)			
1	14:40822	*See* BNL–42907			
CONF-8904255–		(21. international symposium radiation protection physics; Bad Schandau (German Democratic Republic); 3-7 Apr 1989)			
	14:40059	*See* INIS-mf–11483			
CONF-890426–		(Spring meeting of the Materials Research Society; San Diego, CA (USA); 24-28 Apr 1989)			
24	14:40443	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015044/JAW	MF-404

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-890488–		(4. international symposium on ceramics in nuclear waste management; Indianapolis, IN (USA); 23-27 Apr 1989)			
9	14:39981	*See* PNL-SA–16829			
CONF-890491–		(International conference on fifty years of research in nuclear fission; Berlin (Germany, F.R.); 3-7 Apr 1989)			
	14:41238	*See* GSI–89-47(prepr.)			
CONF-890508–		(IEEE international symposium on electromagnetic compatibility; Denver, CO (USA); 23-25 May 1989)			
1	14:40487	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015164/JAW	MF-404
CONF-890509–		(11. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (USA); 8-12 May 1989)			
2	14:39798	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015156/JAW	MF-102
CONF-8905105–		(3. international conference on numerical combustion; Antibes (France); 23-26 May 1989)			
3	14:40679	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015691/JAW	MF-405
CONF-8905115–		(2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation; Luxembourg (Luxembourg); 16-19 May 1989)			
3-Rev.1	14:40874	*See* UCRL–99969-Rev.1			
CONF-8905126–		(Workshop on cold fusion phenomena; Santa Fe, NM (USA); 23-25 May 1989)			
2	14:40667	*See* SAND–89-1273C			
CONF-8905141–		(5. international conference on electrostatic accelerators and associated boosters; Strasbourg (France); 24-27 May 1989)			
3	14:41044	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012503/JAW	MF-414
CONF-8905143–		(NATO international advanced courses on the nuclear equation of state; Peniscola (Spain); 12 May - 3 jun 1989)			
4	14:41249	*See* LBL–27322			
5	14:41148	*See* LBL–27411			
6	14:41033	*See* LBL–27293			
7	14:41135	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015354/JAW	MF-414
CONF-8905144–		(Tau-Charm workshop; Stanford, CA (USA); 23-27 May 1989)			
2	14:41188	*See* SLAC-PUB–5029			
4	14:40751	*See* SLAC-PUB–5011			
CONF-8905146–		(22. Jerusalem symposium on quantum chemistry; Jerusalem (Israel); 15-18 May 1989)			
2	14:40118	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015702/JAW	MF-401;MN-408
CONF-8905166–		(American Society for Mass Spectroscopy annual symposium; Miami Beach, FL (USA); 22-26 May 1989)			
7	14:40934	*See* PNL-SA–16632			
CONF-8905176–		(ASIS mid-year meeting; San Diego, CA (USA); 21-25 May 1989)			
2	14:41408	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014082/JAW	MF-400
CONF-8905183–		(Workshop on physics at the main injector; Batavia, IL (USA); 16-18 May 1989)			
2	14:40777	*See* ANL-HEP-CP–89-54			
3	14:40747	*See* FNAL-TM–1599			
CONF-8905184–		(Institute of Electrical and Electronics Engineers international conference on plasma science; 19. international conference on phenomena in ionized gases (ICPIG-19); Buffalo, NY (USA); 22-24 May 1989; 10-14 jul 1989)			
1	14:41322	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014093/JAW	MF-706
CONF-8905185–		(Pipeline session; New Orleans, LA (USA); 21-24 May 1989)			
1	14:39901	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015160/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8905188–		(Conference on magnetic properties of low-dimensional systems II; San Luis Potosi (Mexico); 22-26 May 1989)			
1	14:40493	*See* LBL–27218			
CONF-8905189–		(USDOE/Pittsburgh Energy Technology Center contractors review meeting; Pleasanton, CA (USA); 16-18 May 1989)			
1	14:39863	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015163/JAW	MF-113
CONF-890524–		(EPA/APCA international symposium on measurement of toxic and related air pollutants; Raleigh, NC (USA); 2-5 May 1989)			
1	14:40823	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013061/JAW	MF-000
CONF-890545–		(6. conference on real-time computer applications in nuclear, particle and plasma physics; Williamsburg, VA (USA); 15-18 May 1989)			
8	14:40783	*See* DOE/ER/03130–47C			
CONF-890555–		(7. power plant dynamics, control and testing symposium; Knoxville, TN (USA); 15-17 May 1989)			
18	14:40243	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015693/JAW	MF-539
19	14:40244	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015692/JAW	MF-539
20	14:40245	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015162/JAW	MF-530
21	14:40246	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015695/JAW	MF-530
22	14:40247	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015694/JAW	MF-530
CONF-890560–		(12. international conference on cyclotrons and their applications; Berlin (Germany, F.R.); 8-12 May 1989)			
	14:40762	*See* GANIL-A–89-02			
	14:40763	*See* GANIL-A–89-03			
	14:40764	*See* GANIL-A–89-06			
CONF-890563–		(CORS/TIMS/ORSA joint national meeting; Vancouver (Canada); 8-10 May 1989)			
2	14:40434	*See* UCRL–100996			
CONF-890594–		(3. advanced inertial confinement fusion accelerator beam dynamics workshop: beam-beam effects in circular colliders; Novosibirsk (USSR); 20 May - 3 jun 1989)			
2	14:40752	*See* SLAC-PUB–5020			
CONF-890610–		(American Solar Energy Society annual meeting; Denver, CO (USA); 19-23 Jun 1989)			
5	14:41037	*See* PNL-SA–16848			
CONF-8906104–		(First symposium on advances in coal spectroscopy; Salt Lake City, UT (USA); 14-16 Jun 1989)			
1	14:39825	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015129/JAW	MF-401
CONF-8906128–		(Special Libraries Association meeting; New York, NY (USA); 10-15 Jun 1989)			
2	14:41380	*See* PNL-SA–16290			
CONF-8906129–		(13. DOE solar photochemistry conference; Silvercreek, CO (USA); 11-15 Jun 1989)			
1	14:40119	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015128/JAW	MF-401
CONF-8906140–		(Health Physics Society summer school; Santa Fe, NM (USA); 19-23 Jun 1989)			
3	14:40876	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015061/JAW	MF-402
CONF-8906153–		(7. topical workshop on proton-antiproton collider physics; Batavia, IL (USA); 20-24 Jun 1989)			
1	14:41078	*See* ANL-HEP-CP–89-07			
CONF-8906155–		(Radiation effects in insulators-5: crystalline oxides and ceramics session; Hamilton (Canada); 19-23 Jun 1989)			
2	14:40496	*See* PNL-SA–16864			
3	14:40549	*See* SAND–89-0857C			
CONF-890616–		(International symposium on thermodynamic analysis and improvement of energy systems; Beijing (China); 5-8 Jun 1989)			
1	14:40168	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015704/JAW	MF-113
CONF-8906161–		(Ion beam analysis conference; Kingston (Canada); 26-30 Jun 1989)			
3	14:41051	*See* SAND–89-0886C			
5	14:41317	*See* SAND–89-0867C			
CONF-8906167–		(6. Scandanavian image analysis conference; Oulu (Finland); 19-22 Jun 1989)			
1	14:41391	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013920/JAW	MF-405

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8906168–		(International conference on selected topics in nuclear structure; Dubna (USSR); 20-24 Jun 1989)			
2	14:41239	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014089/JAW	MF-413
CONF-8906172–		(International joint conference on neural networks; Washington, DC (USA); 19-22 Jun 1989)			
1	14:41396	*See* PNL-SA–16682			
CONF-8906173–		(International symposium on integrated approaches to water pollution problems; Lisbon (Portugal); 19-23 Jun 1989)			
1	14:40915	*See* PNL-SA–16731			
CONF-8906174–		(Conference of the Biometric Society; Davis, CA (USA); 26-28 Jun 1989)			
1	14:40969	*See* PNL-SA–16858			
CONF-8906176–		(Utility opportunities for new generation; Boston, MA (USA); 28-30 Jun 1989)			
1	14:40426	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015135/JAW	MF-101
CONF-8906177–		(21. mid-Atlantic industrial waste conference; Harrisburg, PA (USA); 25-27 Jun 1989)			
1	14:39845	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015136/JAW	MF-602
CONF-8906179–		(Mid-America Chinese Professional annual convention; Chicago, IL (USA); 2-4 Jun 1989)			
1	14:40488	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015703/JAW	MF-406
CONF-890618–		(NICOLS '89: 9th international conference on laser spectroscopy; Bretton Woods, NH (USA); 18-23 Jun 1989)			
3	14:40756	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015130/JAW	MF-411
CONF-8906182–		(Society of Women Engineers national annual meeting; Oakland, CA (USA); 27 Jun - 2 jul 1989)			
1	14:40252	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016633/JAW	MF-530
CONF-8906183–		(Conference on super-intense laser-atom physics; Rochester, NY (USA); 28-30 Jun 1989)			
1-Rev.1	14:41054	*See* UCRL–100709-Rev.1			
CONF-8906184–		(IAEA technical committee meeting on gas-cooled reactor technology, safety and siting; Dimitrovgrad (USSR); 21-23 Jun 1989)			
1	14:40254	*See* GA-A–19674			
CONF-8906186–		(Materials Research Society materials analysis workshop; Albuquerque, NM (USA); 14-17 Jun 1989)			
1	14:41212	*See* BNL-NCS–42989			
CONF-890631–		(International symposium on packaging and transporting of radioactive materials; Washington, DC (USA); 11-16 Jun 1989)			
57	14:40689	*See* GA-A–19415			
58	14:40690	*See* GA-A–19703			
CONF-890658–		(International symposium on nuclear decay data: spectrometric methods, measurements and evaluations; Braunschweig (Germany, F.R.); 6-8 Jun 1989)			
2	14:40801	*See* LA-UR–89-1438			
CONF-890665–		(7. Institute of Electrical and Electronics Engineers pulsed power conference; Monterey, CA (USA); 12-14 Jun 1989)			
35	14:40754	*See* UCRL–100363			
36	14:40702	*See* UCRL–100358			
37	14:40753	*See* UCRL–100321			
38	14:40772	*See* UCRL–100320			
39	14:40771	*See* UCRL–100317			
40	14:40743	*See* UCRL–100322			
42	14:40726	*See* UCRL–100355			
CONF-890666–		(Gasification and gas stream cleanup systems; Morgantown, WV (USA); 27-30 Jun 1989)			
2	14:39808	*See* UCRL–101165			
CONF-890671–		(27. symposium on engineering aspects of magnetohydrodynamics (SEAM); Reno, NV (USA); 27-29 Jun 1989)			
3	14:40377	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015134/JAW	MF-112
CONF-890673–		(IWGFR specialists meeting on advanced controls for fast reactors; Argonne, IL (USA); 20-22 Jun 1989)			
4	14:40248	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015133/JAW	MF-530

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CONF-890680–		(36. annual meeting of the Society of Nuclear Medicine; St. Louis, MO (USA); 13-16 Jun 1989)			
1	14:40676	*See* LBL–27314			
CONF-890692–		(82. Air and Waste Management Association annual meeting and exhibition; Anaheim, CA (USA); 25-30 Jun 1989)			
19	14:40879	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015065/JAW	MF-630
CONF-890697–		(NATO Advanced Study Institute on non-equilibrium processes in partially ionized gases; Acquafredda di Maratea (Italy); 4-17 Jun 1989)			
1	14:41318	*See* UCRL–101309			
CONF-890701–		(International cryogenic materials conference; Los Angeles, CA (USA); 24-28 Jul 1989)			
1	14:41358	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015353/JAW	MF-422
CONF-890703–		(International conference on ion sources; Berkeley, CA (USA); 9-15 Jul 1989)			
13	14:40757	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015856/JAW	MF-420
CONF-890708–		(16. international conference on the physics of electronic and atomic collisions; New York, NY (USA); 26 Jul - 1 aug 1989)			
3	14:41041	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015356/JAW	MF-411
4	14:41042	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015359/JAW	MF-411
5	14:41043	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015365/JAW	MF-414
CONF-8907103–		(Technology-based confidence building: energy and environment; Santa Fe, NM (USA); 9-14 Jul 1989)			
2	14:40335	*See* LA-UR–89-2425			
3	14:40337	*See* UCRL–101401			
CONF-8907104–		(6. symposium on coastal and ocean management; Charleston, SC (USA); 11-14 Jul 1989)			
2	14:41009	*See* PNL-SA–17126			
CONF-8907106–		(Institute of Mathematics and its applications: conference on computational ordinary differential equations; London (UK); 3-7 Jul 1989)			
2	14:41402	*See* UCRL–101209			
CONF-8907107–		(American Society of Nondestructive Testing topical conference; Seattle, WA (USA); 24-27 Jul 1989)			
1	14:40832	*See* UCRL–101263			
CONF-8907108–		(IAEA advisory group meeting on radiation degradation of polymers; Takasaki (Japan); 17-20 Jul 1989)			
1	14:40552	*See* SAND–89-1756C			
CONF-890711–		(5. international conference on emerging nuclear energy systems: ICENES '89; Karlsruhe (Germany, F.R.); 3-6 Jul 1989)			
2	14:41376	*See* UCRL–101286			
CONF-8907112–		(SUBWOG-28; Aldermaston (UK); 10-14 Jul 1989)			
1	14:40550	*See* SAND–89-1060C			
2	14:40551	*See* SAND–89-1061C			
CONF-8907113–		(5. international conference on environmental mutagens; Cleveland, OH (USA); 10-15 Jul 1989)			
1	14:41003	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015073/JAW	MF-408
2	14:40935	*See* UCRL–101218			
3	14:41012	*See* UCRL–101505			
4	14:40936	*See* UCRL–101502			
CONF-8907114–		(International conference on martensitic phase transformations (ICOMAT-89); Sydney (Australia); 3-7 Jul 1989)			
1	14:40440	*See* BNL–43032			
CONF-8907116–		(22. annual international Metallographic Society meeting; Charlotte, NC (USA); 23 Jul 1989)			
1	14:40546	*See* PNL-SA–15740			
CONF-890718–		(International conference on materials and mechanisms of superconductivity - high-temperature superconductors; Stanford, CA (USA); 23-28 Jul 1989)			
9	14:41320	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015060/JAW	MF-410
10	14:40500	*See* SAND–89-0525C			
11	14:40501	*See* UCRL–101082			

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CONF-890721–		(Joint ASME/JSME pressure vessel and piping conference; Honolulu, HI (USA); 23-27 Jul 1989)			
36	14:40238	*See* PNL-SA–16162			
CONF-890730–		(Institute of Electrical and Electronics Engineers international conference on plasma science; 19. international conference on phenomena in ionized gases (ICPIG-19); Buffalo, NY (USA); 22-24 May 1989; 10-14 jul 1989)			
1	14:41322	*See* CONF-8905184–1			
CONF-890736–		(30. annual meeting of the Institute of Nuclear Materials Management; Orlando, FL (USA); 9-12 Jul 1989)			
34	14:40076	*See* DP-MS–89-14			
50	14:40082	*See* PNL-SA–17174			
52	14:39928	*See* LA-UR–89-2241			
53	14:40081	*See* LA-UR–89-2242			
55	14:40694	*See* LA-UR–89-2301			
56	14:40080	*See* LA-UR–89-2214			
57	14:40663	*See* LA-UR–89-2259			
CONF-890746–		(4. international conference on modulated semiconductor structures; Ann Arbor, MI (USA); 17-21 Jul 1989)			
2	14:40548	*See* SAND–89-0534C			
CONF-890759–		(Joint IMA/SPE European conference on the mathematics of oil recovery; Cambridge (UK); 25-27 Jul 1989)			
1	14:39887	*See* UCRL–101566			
CONF-890770–		(Conference on review of progress in quantitative NDE; Brunswick, ME (USA); 23-28 Jul 1989)			
1	14:40720	*See* PNL-SA–16946			
CONF-890791–		(NSF workshop on future directions in electromagnetics research; Boston, MA (USA); 25-27 Jul 1989)			
2	14:41359	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015063/JAW	MF-421
CONF-890795–		(DOE/Sandia crystalline photovoltaic technology project review meeting; Albuquerque, NM (USA); 11-13 Jul 1989)			
	14:40132	*See* SAND–89-1543			
CONF-890798–		(AIRAPT and EHPRG international high pressure science and technology conference; Paderborn (Germany, F.R.); 17-21 Jul 1989)			
3	14:40553	*See* SAND–89-1828C			
5	14:40478	*See* LA-UR–89-2486			
CONF-890810–		(Seminar on small and medium sized reactors, design, safety and marketing potential; San Diego, CA (USA); 21-23 Aug 1989)			
1	14:40344	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013014/JAW	MF-500
2	14:40277	*See* GA-A–19713			
CONF-8908102–		(Society of Core Analysts annual conference; New Orleans, LA (USA); 1-3 Aug 1989)			
1	14:41018	*See* SAND–89-0087C			
CONF-890811–		(9. international symposium on detonation; Portland, OR (USA); 28 Aug - 1 sep 1989)			
2	14:40848	*See* SAND–89-0196C			
3	14:40846	*See* SAND–88-2292C			
4	14:40847	*See* SAND–89-0180C			
7	14:40843	*See* LA-UR–89-689			
9	14:40842	*See* LA-UR–89-601			
10	14:40840	*See* LA-UR–89-520			
11	14:40839	*See* LA-UR–89-459			
12	14:40838	*See* LA-UR–89-434			
13	14:40837	*See* LA-UR–89-433			
14	14:40836	*See* LA-UR–89-432			
15	14:40835	*See* LA-UR–89-431			
16	14:40662	*See* LA-UR–89-374			
17	14:40841	*See* LA-UR–89-536			
20	14:40547	*See* SAND–88-1519C			
21	14:40410	*See* SAND–88-2380C			
22	14:40850	*See* UCRL–100644			
23	14:40844	*See* LA-UR–89-872			
24	14:40845	*See* LA-UR–89-1345			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
25	14:40849	*See* SAND--89-2504C			
CONF-890812--		(American Physical Society topical conference on shock compression of condensed matter; Albuquerque, NM (USA); 14-17 Aug 1989)			
2	14:41332	*See* SAND--89-0643C			
CONF-890815--		(24. intersociety energy conversion engineering conference; Washington, DC (USA); 7-12 Aug 1989)			
17	14:40144	*See* DOE/NASA/33408--3			
CONF-890819--		(ASME/AIChE national heat transfer conference; Philadelphia, PA (USA); 6-9 Aug 1989)			
14	14:40265	*See* BNL-NUREG--42533			
CONF-890821--		(13. international conference on atomic collisions in solids; Aarhus (Denmark); 7-11 Aug 1989)			
1	14:41265	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015860/JAW	MF-404;MN-411
CONF-890836--		(33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA (USA); 6-11 Aug 1989)			
1	14:40824	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015067/JAW	MF-406
2	14:41031	*See* LA-UR--89-2381			
CONF-890843--		(International symposium of robotics research; Tokyo (Japan); 28-31 Aug 1989)			
1	14:40700	*See* SAND--89-0053C			
2	14:40699	*See* SAND--88-3279C			
CONF-890845--		(4. international energy conservation program evaluation conference; Chicago, IL (USA); 21-25 Aug 1989)			
1	14:40338	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014073/JAW	MF-350
2	14:40339	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015045/JAW	MF-350
CONF-890846--		(International test conference; Washington, DC (USA); 29-31 Aug 1989)			
1	14:40724	*See* SAND--88-3442C			
CONF-890847--		(Electron Microscopy Society of America annual meeting; San Antonio, TX (USA); 6-11 Aug 1989)			
1	14:41315	*See* LBL--27321			
CONF-890854--		(11. annual DOE low level waste management conference; Pittsburgh, PA (USA); 22-24 Aug 1989)			
1	14:40673	*See* DP-MS--89-59			
2	14:40883	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014760/JAW	MF-511
3	14:40056	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014067/JAW	MF-721
4	14:40057	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014079/JAW	MF-721
6	14:39947	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015900/JAW	MF-403
CONF-890855--		(10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989)			
2	14:40203	*See* SAND--88-2237C			
3	14:40211	*See* SAND--88-2190C			
9	14:40270	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009782/JAW	MF-000
40	14:40266	*See* BNL-NUREG--42676			
44	14:40267	*See* BNL-NUREG--42677			
CONF-890856--		(IUTAM symposium; Gottingen (Germany, F.R.); 28 Aug - 1 sep 1989)			
1	14:41074	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008634/JAW	MF-406
CONF-890866--		(11. boundary elements conference; Boston, MA (USA); 29-31 Aug 1989)			
1	14:41390	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010839/JAW	MF-405
CONF-890875--		(3. international symposium on foundations of quantum mechanics; Tokyo (Japan); 27-31 Aug 1989)			
1	14:41333	*See* SLAC-PUB--4951			
CONF-890876--		(Waterpower '89: international conference on hydropower; Buffalo, NY (USA); 23-25 Aug 1989)			
1	14:40114	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012505/JAW	MF-11
CONF-890885--		(Flash radiography topical symposium; Portland, OR (USA); 15-18 Aug 1989)			
2	14:40693	*See* LA-UR--89-1636			
3	14:40830	*See* LA-UR--89-1886			
CONF-890887--		(Medical defense bioscience review; Columbia, MD (USA); 15-17 Aug 1989)			
1	14:41011	*See* UCRL--101200			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-890888–		(IEEE international conference on systems engineering; Dayton, OH (USA); 24-26 Aug 1989)			
1	14:40687	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013052/JAW	MF-406
CONF-890889–		(5. annual symposium on technical displays on physical and electronic security; Philadelphia, PA (USA); 15-17 Aug 1989)			
1	14:41398	*See* SAND–89-1308C			
2	14:40079	*See* LA-UR–89-1559			
3	14:40701	*See* SAND–89-0540C			
4	14:40083	*See* SAND–89-1409C			
CONF-890890–		(9. international heat transfer conference; Jerusalem (Israel); 19-24 Aug 1989)			
1	14:40713	*See* SAND–89-1301C			
CONF-890892–		(12. international congress on cybernetics; Namur (Belgium); 21-25 Aug 1989)			
1	14:41401	*See* UCRL–101085			
CONF-890893–		(Annual Tex users group; Stanford, CA (USA); 20-23 Aug 1989)			
1	14:41394	*See* LA-UR–89-2125			
CONF-890896–		(2. international symposium on antennae and EM theory; Shanghai (China); 29 Aug - 1 sep 1989)			
1	14:41334	*See* UCRL–100236			
CONF-890898–		(IES annual conference; Orlando, FL (USA); 6-10 Aug 1989)			
1	14:40391	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014520/JAW	MF-350
CONF-890899–		(Joint Korea-United States seminar on expert systems for electric power systems and industries; Seoul (Republic of Korea); 13-18 Aug 1989)			
1	14:40249	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015064/JAW	MF-000
CRIE–					
T-87063	14:40179	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760356/JAW	MF-000
T-87064	14:40180	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760355/JAW	MF-000
T-87065	14:40181	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo,Japan		DE89760354/JAW	MF-000
T-87067	14:40381	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan		DE89772382/JAW	MF-000
T-87069	14:40857	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760376/JAW	MF-000
T-87078	14:40182	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760379/JAW	MF-000
T-87079	14:41075	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 2-11-1, Iwato-kita, Komae, Tokyo, Japan		DE89772355/JAW	MF-000
T-87082	14:40183	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760360/JAW	MF-000
T-87083	14:40184	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760361/JAW	MF-000
T-87087	14:40185	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772351/JAW	MF-000
T-87098	14:40328	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760380/JAW	MF-000
T-87101	14:40186	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772352/JAW	MF-000
T-87102	14:41013	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772353/JAW	MF-000

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T-87107	14:40187	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760357/JAW	MF-000
T-87108	14:40169	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760358/JAW	MF-000
T-87111	14:40170	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760375/JAW	MF-000
T-87114	14:40188	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760359/JAW	MF-000
T-87115	14:41014	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760378/JAW	MF-000
T-88001	14:40189	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760377/JAW	MF-000
T-88003	14:39904	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772354/JAW	MF-000
U-87030	14:40171	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772348/JAW	MF-000
U-87067	14:40157	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760367/JAW	MF-000
U-87072	14:40860	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772349/JAW	MF-000
U-87075	14:40172	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760366/JAW	MF-000
U-87076	14:40115	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan		DE89772380/JAW	MF-000
U-88010	14:40909	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst., of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan		DE89772379/JAW	MF-000
U-88012	14:40158	NTIS (US Sales Only), PC A05/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772346/JAW	MF-000
U-88013	14:41024	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan		DE89772381/JAW	MF-000
U-88016	14:41020	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89772347/JAW	MF-000
W-87014	14:40173	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760381/JAW	MF-000
W-87024	14:40190	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760387/JAW	MF-000
W-87025	14:40191	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760386/JAW	MF-000
W-87034	14:39869	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760385/JAW	MF-000
W-87038	14:39781	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760383/JAW	MF-000
W-87039	14:40174	NTIS (US Sales Only), PC A04/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760384/JAW	MF-000
W-87042	14:40489	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760382/JAW	MF-000

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Y-88006	14:40351	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760362/JAW	MF-000
Y-88007	14:40924	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760363/JAW	MF-000
Y-88008	14:40925	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760364/JAW	MF-000
Y-88009	14:40926	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760365/JAW	MF-000
Y-88011	14:40175	NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry. 1-6-1, Ote-machi, Chiyoda-ku, Tokyo		DE89760422/JAW	MF-000
Y-88014	14:40369	NTIS (US Sales Only), PC A03/MF A01 - Abailable from Central Research Inst. of Electric Power Industry, Tokyo (Japan)		DE89772360/JAW	MF-000
CRN-CPR–					
88-06	14:40510	NTIS (US Sales Only), PC A05/MF A01		DE89903287/JAW	MF-000
88-07	14:40511	NTIS (US Sales Only), PC A07/MF A01		DE89903288/JAW	MF-000
88-09	14:40512	NTIS (US Sales Only), PC A05/MF A01		DE89903290/JAW	MF-000
88-10	14:40780	NTIS (US Sales Only), PC A05/MF A01		DE89903311/JAW	MF-000
88-11	14:40615	NTIS (US Sales Only), PC A05/MF A01		DE89903312/JAW	MF-000
CRN-HE–					
88-02	14:40775	NTIS (US Sales Only), PC A09/MF A01		DE89903313/JAW	MF-000
88-09	14:41136	NTIS (US Sales Only), PC A07/MF A01		DE89903314/JAW	MF-000
CRN-PN–					
87-33	14:40573	NTIS (US Sales Only), PC A05/MF A01		DE89903289/JAW	MF-000
88-23	14:41225	NTIS (US Sales Only), PC A02/MF A01		DE89903161/JAW	MF-000
88-33	14:41232	NTIS (US Sales Only), PC A07/MF A01		DE89903310/JAW	MF-000
88-39	14:41323	NTIS (US Sales Only), PC A02/MF A01		DE89903223/JAW	MF-000
89-1	14:40781	NTIS (US Sales Only), PC A03/MF A01		DE89903218/JAW	MF-000
89-02	14:41189	NTIS (US Sales Only), PC A03/MF A01		DE89903225/JAW	MF-000
CRN-VIV–					
55/1	14:40734	NTIS (US Sales Only), PC A02/MF A01		DE89903297/JAW	MF-000
59	14:40758	NTIS (US Sales Only), PC A02/MF A01		DE89903300/JAW	MF-000
DFVLR-Mitt.–					
88-31	14:40160	NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89794862/JAW	MF-000
DNE–					
9015032-Pt.2A	14:40684	NTIS (US Sales Only), PC A07/MF A01 - OSTI		DE89015032/JAW	MF-000
9015033-Pt.2B	14:40340	NTIS (US Sales Only), PC A09/MF A01 - OSTI		DE89015033/JAW	MF-000
9015034-Pt.1	14:40341	NTIS (US Sales Only), PC A11/MF A01 - OSTI		DE89015034/JAW	MF-000
9015035-Pt.4	14:40342	NTIS (US Sales Only), PC A07/MF A01 - OSTI		DE89015035/JAW	MF-000
DOE-RW–					
88.108	14:40574	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632460/JAW	MF-000
89.002	14:39945	*See* AERE-R–12957(Rev.)			
89.008	14:39953	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89633765/JAW	MF-000
89.015	14:40918	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89632950/JAW	MF-000
89.018	14:39954	NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS		DE89633766/JAW	MF-000
89.020	14:39946	*See* AERE-R–13369			
89.030	14:39955	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633768/JAW	MF-000
DOE/CE/40637–					
T7	14:40413	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014547/JAW	PC-310;STD-310
DOE/CE/40735–					
1	14:40110	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009029/JAW	PC-310;STD-310
DOE/CE/90027–					
1	14:40414	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015096/JAW	MF-310
DOE/CE/90213–					
T1	14:40680	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015147/JAW	MF-362
T2	14:40681	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015148/JAW	MF-362
T3	14:40682	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015149/JAW	MF-362
T4	14:40728	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015819/JAW	MF-362
DOE/CH–					
8901	14:40055	*See* ANL/ES–160			

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DOE/CH/10093–					
52	14:40317	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000867/JAW	MF-201
DOE/EIA–					
0112(79)	14:39893	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014983/JAW	MF-950
0181(79)	14:40361	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014977/JAW	MF-950
0181(81)	14:40362	NTIS, PC A02/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014976/JAW	MF-950
0184/2	14:40334	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014993/JAW	MF-950
0226(89/04)	14:40370	NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015735/JAW	MF-950
0230	14:41378	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014984/JAW	MF-950
0264	14:40357	NTIS, PC A11/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014995/JAW	MF-950
0285	14:40375	NTIS, PC A20/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015005/JAW	MF-950
0294	14:39883	NTIS, PC A17/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015003/JAW	MF-950
0380(89/04)	14:39895	NTIS, PC A10/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015737/JAW	MF-950
0414	14:40363	NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015001/JAW	MF-950
0520(89/07)	14:40364	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015736/JAW	MF-950
M039	14:40371	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015159/JAW	MF-950
DOE/ER–					
0413	14:40782	NTIS, PC A03/MF A01 - OSTI		DE89013876/JAW	MF-414
DOE/ER/01112–					
14	14:41137	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014859/JAW	MF-414
DOE/ER/01428–					
T1	14:41138	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014695/JAW	MF-414
T2	14:41196	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012685/JAW	MF-414
T3	14:41197	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012684/JAW	MF-414
T4	14:41139	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012683/JAW	MF-414
T5	14:41140	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012682/JAW	MF-414
T7	14:41141	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015048/JAW	MF-414
DOE/ER/03130–					
47C	14:40783	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013960/JAW	MF-414
49C	14:41027	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013959/JAW	MF-414
DOE/ER/10699–					
1	14:40784	NTIS, PC A06/MF A01 - OSTI		DE89015017/JAW	MF-414
DOE/ER/13065–					
582	14:41142	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014890/JAW	MF-414
DOE/ER/13367–					
4	14:40929	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015816/JAW	MF-408
DOE/ER/13424–					
3	14:40930	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015798/JAW	MF-408
DOE/ER/13425–					
3	14:40931	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015799/JAW	MF-408
DOE/ER/13488–					
3	14:40616	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015036/JAW	MF-406
DOE/ER/13614–					
3	14:40104	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015790/JAW	MF-408
DOE/ER/13621–					
3	14:40120	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015796/JAW	MF-408
DOE/ER/13739–					
2	14:40121	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015815/JAW	MF-408
DOE/ER/25057–					
1	14:41392	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015443/JAW	MF-405
DOE/ER/40314–					
3	14:41213	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015929/JAW	MF-413
DOE/ER/40315–					
161	14:41214	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015015/JAW	MF-413
DOE/ER/45258–					
T3	14:40490	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015758/JAW	MF-404
DOE/ER/45271–					
T3	14:40513	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015022/JAW	MF-404
DOE/ER/45281–					
3	14:40444	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015016/JAW	MF-404
DOE/ER/53187–					
T5	14:41337	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015935/JAW	MF-421
DOE/ER/53194–					
2	14:41076	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015806/JAW	MF-410
DOE/ER/53241–					
3	14:41338	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015813/JAW	MF-426
DOE/ER/53266–					
2	14:41339	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015126/JAW	MF-427
DOE/ER/53267–					
2	14:41340	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015152/JAW	MF-421

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DOE/ER/60285–6	14:41025	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015814/JAW	MF-402
DOE/ER/60338–7	14:41026	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015809/JAW	MF-403
DOE/ER/60393–4	14:40952	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015925/JAW	MF-408
DOE/ER/60512–3	14:40672	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015805/JAW	MF-408
DOE/ER/60514–3	14:40617	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015804/JAW	MF-401
DOE/ET/10815–T7	14:40378	NTIS, PC A02/MF A01 - OSTI		DE89015802/JAW	MF-112
DOE/ET/51013–267	14:41360	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014856/JAW	MF-420
268	14:41361	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014857/JAW	MF-420
270	14:41362	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015786/JAW	MF-425
DOE/ET/53088–5	14:41341	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015811/JAW	MF-427
DOE/FC/10619–2724	14:39846	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011690/JAW	PC-107;STD-107
DOE/FE/60603–T4	14:40365	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015963/JAW	MF-121
DOE/ID–10235	14:40323	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014341/JAW	PC-331
DOE/ID/01570–4	14:41363	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015788/JAW	MF-501
5	14:41364	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015787/JAW	MF-501;MN-505
DOE/ID/12617–T1	14:40113	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015962/JAW	MF-225
DOE/ID/12626–2	14:40415	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009027/JAW	PC-311;STD-311
DOE/IG–0268	14:40880	OSTI		TI89014344/JAW	PC-960
DOE/IR/05106–T112	14:40427	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015421/JAW	MF-350
DOE/MC/21136–21	14:39886	NTIS, PC A15/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000756/JAW	PC-122
DOE/MC/23167–2678-Vol.1	14:39870	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000953/JAW	PC-111;STD-111
DOE/MC/23248–2709	14:39871	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000994/JAW	PC-103;STD-103
DOE/NASA/33408–3	14:40144	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013337/JAW	PC-236
DOE/NE/44139–24	14:39948	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009018/JAW	PC-510;STD-510
47	14:39949	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009020/JAW	PC-510;STD-510
49	14:39950	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009019/JAW	PC-510;STD-510
50	14:39951	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009015/JAW	PC-510;STD-510
54	14:40058	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009017/JAW	PC-510;STD-510
DOE/OR/00033–T428	14:41365	NTIS, PC A18/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015495/JAW	MF-422

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
T429	14:40445	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015494/JAW	MF-404
DOE/OR/21400–					
T379	14:40861	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015892/JAW	MF-402
DOE/PC/60782–					
T3	14:39799	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011426/JAW	PC-108;STD-108
DOE/PC/63049–					
T2	14:39782	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015146/JAW	PC-102;STD-102
DOE/PC/79668–					
T4-Vol.2	14:40379	NTIS, PC A04/MF A01 - OSTI		DE89015743/JAW	PC-112;STD-112
DOE/PC/79672–					
T1	14:40380	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89002711/JAW	PC-112;STD-112
DOE/PC/79907–					
T6	14:39826	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015855/JAW	MF-102
DOE/PC/79915–					
T5	14:39872	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015854/JAW	MF-103
DOE/PC/80524–					
T15	14:39864	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015741/JAW	PC-102;STD-102
DOE/PC/88850–					
T1	14:39847	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014128/JAW	PC-105;STD-105
DOE/PC/88854–					
T1	14:39800	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015878/JAW	MF-105
DOE/PC/88873–					
T3	14:39848	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015763/JAW	MF-105
DOE/PC/88877–					
T1	14:39783	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014127/JAW	MF-102
DOE/PC/88883–					
T3	14:39784	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015883/JAW	MF-102
DOE/PC/88910–					
T2	14:39873	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015882/JAW	MF-107
DOE/PC/88943–					
T1	14:39849	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015768/JAW	MF-113
DOE/RL–					
89-05	14:39952	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015387/JAW	MF-510
DOE/RW–					
0243	14:39956	OSTI		TI89013970/JAW	MF-800
DP-MS–					
89-14	14:40076	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014142/JAW	MF-711
89-59	14:40673	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013716/JAW	MF-721
EA–					
1989-1	14:39850	American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 (USA)			ND-000
ECN–					
213	14:40240	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89620228/JAW	MF-000
89-073	14:40142	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-081	14:39801	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-087	14:39874	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-100	14:40161	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-101	14:39802	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-102	14:40143	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-103	14:40159	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-107	14:40162	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000

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89-109	14:40324	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
ECRC/M–					
2363	14:40192	Available from: Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.			ND-000
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2290	14:40392	Available from: Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.			ND-000
2386	14:40193	Available from: Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.			ND-000
EGG–					
10617-1004	14:40884	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014330/JAW	PC-510
ENEA-RT-PAS–					
89-2	14:40200	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89633529/JAW	MF-000
EPRI-AP–					
6022	14:40416	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-EL–					
4651-Vol.2	14:40194	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
4651-Vol.4	14:40195	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6426	14:40196	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6461	14:40197	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6462-M	14:40198	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-GS–					
6397	14:40176	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6439	14:39803	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6441-Vol.1	14:40446	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6441-Vol.2	14:40447	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
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6075-SR	14:40234	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
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6369	14:40372	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000

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EPRI-P–					
6385	14:40373	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
ERCB–					
GB89-5	14:39898	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, Canada T2P 3G4; $N/C.			ND-000
ERCB-D–					
89-2	14:40928	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, Canada T2P 3G4; $N/C.			ND-000
ESC-WR–					
89-09	14:40366	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-10	14:40332	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-11	14:40374	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-12	14:40862	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
ETDE-mf–					
9794648	14:40417	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A07/MF A01		DE89794648/JAW	MF-000
9794743	14:41004	NTIS (US Sales Only), PC A02/MF A01; NTIS (US Sales Only), PC A02/MF A01		DE89794743/JAW	MF-000
9794744	14:40575	NTIS (US Sales Only), PC A10/MF A01; NTIS (US Sales Only), PC A10/MF A01		DE89794744/JAW	MF-000
9794746	14:41005	NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89794746/JAW	MF-000
9794747	14:41006	NTIS (US Sales Only), PC A13/MF A01; NTIS (US Sales Only), PC A13/MF A01		DE89794747/JAW	MF-000
9794748	14:40099	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01		DE89794748/JAW	MF-000
9794749	14:40932	NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01		DE89794749/JAW	MF-000
9794750	14:41007	NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01		DE89794750/JAW	MF-000
9794801	14:39785	NTIS (US Sales Only), PC A11/MF A01; NTIS (US Sales Only), PC A07/MF A01		DE89794801/JAW	MF-000
9794850	14:40149	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89794850/JAW	MF-000
9794853	14:40329	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89794853/JAW	MF-000
9794876	14:40431	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A02/MF A01		DE89794876/JAW	MF-000
9794894	14:40408	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89794894/JAW	MF-000
9795080	14:40409	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A05/MF A01		DE89795080/JAW	MF-000
9795087	14:40418	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89795087/JAW	MF-000
9795107	14:40122	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89795107/JAW	MF-000
9795113	14:40927	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89795113/JAW	MF-000
ETEC–					
89-3	14:39967	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014331/JAW	PC-511
ETSU-R–					
46	14:40155	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks., LS23 7BQ		DE89790668/JAW	MF-000
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10281	14:40156	NTIS (US Sales Only), PC A04/MF A01			MF-000
10313	14:40150	NTIS (US Sales Only), PC A04/MF A01			MF-000
10386	14:40123	NTIS (US Sales Only), PC A03/MF A01			MF-000
10387	14:40376	NTIS (US Sales Only), PC A07/MF A01			MF-000
10550	14:40393	NTIS (US Sales Only), PC A05/MF A01			MF-000
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10905	14:40394	NTIS (US Sales Only), PC A06/MF A01			MF-000
10928	14:40320	NTIS (US Sales Only), PC A03/MF A01			MF-000
10959	14:40325	NTIS (US Sales Only), PC A03/MF A01			MF-000
11062	14:40151	NTIS (US Sales Only), PC A03/MF A01			MF-000
11193	14:40420	NTIS (US Sales Only), PC A03/MF A01			MF-000
11195	14:40100	NTIS (US Sales Only), PC A03/MF A01			MF-000
11226	14:40867	NTIS (US Sales Only), PC A08/MF A01			MF-000

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11624	14:40077	NTIS (US Sales Only), PC A03/MF A01			MF-000
11752	14:41266	NTIS (US Sales Only), PC A03/MF A01			MF-000
11797	14:39860				ND-000
11826	14:40868	NTIS (US Sales Only), PC A03/MF A01			MF-000
11828	14:40869	NTIS (US Sales Only), PC A04/MF A01			MF-000
11845	14:39851				ND-000
11846	14:39877				ND-000
11848	14:39968	NTIS (US Sales Only), PC A08/MF A01			MF-000
11896	14:39969	NTIS (US Sales Only), PC A06/MF A01			MF-000
11925	14:40219	NTIS (US Sales Only), PC A07/MF A01			MF-000
11955	14:41366	NTIS (US Sales Only), PC A14/MF A01			MF-000
11995	14:40274	NTIS (US Sales Only), PC A04/MF A01			MF-000
12022	14:40514	NTIS (US Sales Only), PC A03/MF A01			MF-000
12024	14:39970	NTIS (US Sales Only), PC A05/MF A01			MF-000
12050	14:40688	NTIS (US Sales Only), PC A05/MF A01			MF-000
12052	14:39971	NTIS (US Sales Only), PC A03/MF A01			MF-000
12053	14:39972	NTIS (US Sales Only), PC A04/MF A01			MF-000
12062	14:39973	NTIS (US Sales Only), PC A04/MF A01			MF-000
12121	14:40785	NTIS (US Sales Only), PC A06/MF A01			MF-000
9340	14:40419	NTIS (US Sales Only), PC A04/MF A01			MF-000
EWE–					
2618.032	14:39955	*See* DOE-RW–89.030			
FEI–					
1888	14:40275	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633485/JAW	MF-000
1892	14:41267	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631824/JAW	MF-000
1893	14:40220	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633486/JAW	MF-000
1894	14:40262	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633617/JAW	MF-000
1898	14:40241	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633505/JAW	MF-000
1902	14:41256	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632245/JAW	MF-000
1913	14:40221	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89633603/JAW	MF-000
1915	14:40078	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633832/JAW	MF-000
FERMILAB-PUB–					
89/140-A	14:41028	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015245/JAW	MF-412
89/147-A	14:41324	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015246/JAW	MF-410
89/156-A	14:41029	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015244/JAW	MF-412
FFA-TN–					
1988-53	14:40723	*See* STEV-VIND–89-11			
FFAP–					
201	14:40166	*See* STEV-VIND–89-12			
FNAL-TM–					
1577	14:40761	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014360/JAW	PC-414
1591	14:40786	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014357/JAW	PC-414
1598	14:40737	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014356/JAW	PC-414
1599	14:40747	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014355/JAW	PC-414
963	14:40760	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014358/JAW	PC-414
FNAL/C–					
89/87	14:40746	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015141/JAW	MF-414
89/92	14:40759	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015142/JAW	MF-414
FRCEA-TH–					
187	14:40276	NTIS (US Sales Only), PC A13/MF A01		DE89903168/JAW	MF-000
200	14:40199	NTIS (US Sales Only), PC A05/MF A01		DE89903158/JAW	MF-000
202	14:40618	NTIS (US Sales Only), PC A11/MF A01		DE89903270/JAW	MF-000
58	14:41143	NTIS (US Sales Only), PC A07/MF A01		DE89903163/JAW	MF-000
FRNC-R–					
305	14:40229	NTIS (US Sales Only), PC A11/MF A01		DE89903304/JAW	MF-000
FRNC-TH–					
3341	14:41342	NTIS (US Sales Only), PC A12/MF A01		DE89903170/JAW	MF-000
3396	14:40222	NTIS (US Sales Only), PC A10/MF A01		DE89903305/JAW	MF-000
3443-1	14:39914	NTIS (US Sales Only), PC A08/MF A01		DE89903251/JAW	MF-000
3443-2	14:39915	NTIS (US Sales Only), PC A06/MF A01		DE89903250/JAW	MF-000
3460	14:40449	NTIS (US Sales Only), PC A08/MF A01		DE89903269/JAW	MF-000
3464	14:41016	NTIS (US Sales Only), PC A12/MF A01		DE89903276/JAW	MF-000
3466	14:40576	NTIS (US Sales Only), PC A08/MF A01		DE89903249/JAW	MF-000
GA-A–					
19415	14:40689	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014251/JAW	MF-820
19674	14:40254	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015091/JAW	MF-522
19703	14:40690	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014247/JAW	MF-820
19713	14:40277	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015750/JAW	MF-522
GANIL-A–					
89-02	14:40762	NTIS (US Sales Only), PC A02/MF A01		DE89903235/JAW	MF-000
89-03	14:40763	NTIS (US Sales Only), PC A02/MF A01		DE89903234/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-06	14:40764	NTIS (US Sales Only), PC A02/MF A01		DE89903233/JAW	MF-000
GANIL-P–					
88-07	14:41222	NTIS (US Sales Only), PC A03/MF A01		DE89903159/JAW	MF-000
88-13	14:41215	NTIS (US Sales Only), PC A03/MF A01		DE89903303/JAW	MF-000
GKSS–					
88/E/63	14:40450	NTIS (US Sales Only), PC A02/MF A01		DE89795114/JAW	MF-000
88/E/64	14:40914	NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01		DE89794919/JAW	MF-000
GSF–					
2/89	14:40939	NTIS (US Sales Only), PC A03/MF A01		DE89794857/JAW	MF-000
GSI–					
89-34(prepr.)	14:41216	NTIS (US Sales Only), PC A03/MF A01		DE89795123/JAW	MF-000
89-35(prepr.)	14:41176	NTIS (US Sales Only), PC A02/MF A01		DE89795122/JAW	MF-000
89-41(prepr.)	14:41367	NTIS (US Sales Only), PC A03/MF A01		DE89795126/JAW	MF-000
89-43(prepr.)	14:41045	NTIS (US Sales Only), PC A03/MF A01		DE89795125/JAW	MF-000
89-44(prepr.)	14:41242	NTIS (US Sales Only), PC A04/MF A01		DE89795124/JAW	MF-000
89-46(prepr.)	14:41046	NTIS (US Sales Only), PC A03/MF A01		DE89795130/JAW	MF-000
89-47(prepr.)	14:41238	NTIS (US Sales Only), PC A03/MF A01		DE89795131/JAW	MF-000
89-48(prepr.)	14:41235	NTIS (US Sales Only), PC A03/MF A01		DE89795129/JAW	MF-000
HEDL-SA–					
3626	14:40223	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014953/JAW	MF-537
3690	14:39912	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014944/JAW	MF-537
3712	14:40250	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014943/JAW	MF-530
HU-TFT–					
87-15	14:41177	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632158/JAW	MF-000
87-26	14:41178	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632159/JAW	MF-000
87-27	14:41179	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632160/JAW	MF-000
89-22	14:41180	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89632161/JAW	MF-000
IA–					
1411	14:40215	NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS		DE89633590/JAW	MF-000
IAE–					
4672/7	14:41343	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89632018/JAW	MF-000
4720/3	14:41382	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633853/JAW	MF-000
4732/16	14:41344	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632014/JAW	MF-000
IEACR–					
16	14:39882	IEA Coal Research, 14-15 Lower Grosvenor Place, London, SW1W 0EX, England			PC-101
IFT-P–					
31/88	14:41325	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631649/JAW	MF-000
IFUSP-P–					
737	14:41243	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632312/JAW	MF-000
743	14:41030	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89632076/JAW	MF-000
761	14:41228	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632411/JAW	MF-000
762	14:40765	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633442/JAW	MF-000
763	14:41326	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631631/JAW	MF-000
IFVE-ONF–					
88-14	14:40787	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633708/JAW	MF-000
88-28	14:40825	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633753/JAW	MF-000
IGCAR–					
78	14:40577	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630797/JAW	MF-000
IKDA–					
88-14	14:40738	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89794773/JAW	MF-000
IKE–					
6-177	14:40230	NTIS (US Sales Only), PC A06/MF A01		DE89795118/JAW	MF-000
ILWRP–					
87-P16	14:40574	*See* DOE-RW–88.108			
87-P7	14:40677	*See* NSS/R–116			
INDC(JPN)–					
121-L	14:40231	NTIS (US Sales Only), PC A03/MF A01		DE89903236/JAW	MF-000
122/L	14:41227	*See* JAERI-M–89-046			
INFN-BE–					
89-1	14:40788	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633709/JAW	MF-000
INFN-LNF–					
89-002(R)	14:40748	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633420/JAW	MF-000
INIS-BR–					
1551	14:40091	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633080/JAW	MF-000
1552	14:40085	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633827/JAW	MF-000
1553	14:40086	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89633822/JAW	MF-000
1554	14:40451	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89632792/JAW	MF-000
1555	14:41047	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89631805/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
1556	14:41268	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89631825/JAW	MF-000
1557	14:40452	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89632726/JAW	MF-000
INIS-GB–					
193	14:41244	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89632250/JAW	MF-000
INIS-SU–					
98	14:41271	NTIS (US Sales Only), PC A08/MF A01; INIS		DE89012189/JAW	MF-000
INIS-XE–					
1	14:40256	NTIS (US Sales Only), PC A10/MF A01		DE89903253/JAW	MF-000
2	14:40257	NTIS (US Sales Only), PC A04/MF A01		DE89903255/JAW	MF-000
3	14:40258	NTIS (US Sales Only), PC A06/MF A01		DE89903256/JAW	MF-000
INIS-mf–					
11460	14:40715	NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS		DE89012188/JAW	MF-000
11464	14:40870	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619715/JAW	MF-000
11482	14:40255	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631288/JAW	MF-000
11483	14:40059	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633108/JAW	MF-000
11491	14:40054	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89633088/JAW	MF-000
11493	14:41383	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633854/JAW	MF-000
11494	14:40669	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89632645/JAW	MF-000
11495	14:40579	NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS		DE89632463/JAW	MF-000
11497	14:40232	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89633487/JAW	MF-000
11498	14:40236	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89633493/JAW	MF-000
11499	14:40606	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89632496/JAW	MF-000
11501	14:41269	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89631929/JAW	MF-000
11502	14:40060	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89633078/JAW	MF-000
11985	14:40826	NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01		DE89794896/JAW	MF-000
11986	14:41022	NTIS (US Sales Only), PC A04/MF A01		DE89795009/JAW	MF-000
11988	14:40454	NTIS (US Sales Only), PC A12/MF A01		DE89794808/JAW	MF-000
11992	14:41245	NTIS (US Sales Only), PC A13/MF A01		DE89795177/JAW	MF-000
11993	14:40347	NTIS (US Sales Only), PC A12/MF A01		DE89795119/JAW	MF-000
INP–					
1302/PS	14:41217	NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS		DE89632395/JAW	MF-000
IPNO-DRE–					
88-08	14:41247	NTIS (US Sales Only), PC A07/MF A01		DE89903220/JAW	MF-000
88-19	14:41050	NTIS (US Sales Only), PC A04/MF A01		DE89903307/JAW	MF-000
88-23	14:41144	NTIS (US Sales Only), PC A02/MF A01		DE89903216/JAW	MF-000
88-30	14:40792	NTIS (US Sales Only), PC A03/MF A01		DE89903214/JAW	MF-000
88-32	14:40793	NTIS (US Sales Only), PC A03/MF A01		DE89903215/JAW	MF-000
88-35	14:41145	NTIS (US Sales Only), PC A02/MF A01		DE89903217/JAW	MF-000
88-36	14:41218	NTIS (US Sales Only), PC A03/MF A01		DE89903308/JAW	MF-000
88-38	14:40608	NTIS (US Sales Only), PC A03/MF A01		DE89903309/JAW	MF-000
IPNO-T–					
89-01	14:40692	NTIS (US Sales Only), PC A05/MF A01		DE89903222/JAW	MF-000
89-02	14:41233	NTIS (US Sales Only), PC A10/MF A01		DE89903221/JAW	MF-000
89-03	14:40674	NTIS (US Sales Only), PC A09/MF A01		DE89903306/JAW	MF-000
89-04	14:41229	NTIS (US Sales Only), PC A07/MF A01		DE89903286/JAW	MF-000
IPNO-TH–					
88-74	14:41199	NTIS (US Sales Only), PC A03/MF A01		DE89903228/JAW	MF-000
88-75	14:41200	NTIS (US Sales Only), PC A03/MF A01		DE89903229/JAW	MF-000
IPP–					
5/27	14:41345	NTIS (US Sales Only), PC A03/MF A01		DE89794785/JAW	MF-000
ISN–					
88-102	14:41219	NTIS (US Sales Only), PC A07/MF A01		DE89903292/JAW	MF-000
88-70	14:41257	NTIS (US Sales Only), PC A07/MF A01		DE89903219/JAW	MF-000
88-71	14:41248	NTIS (US Sales Only), PC A10/MF A01		DE89903284/JAW	MF-000
88-81	14:41234	NTIS (US Sales Only), PC A07/MF A01		DE89903294/JAW	MF-000
88-82	14:40794	NTIS (US Sales Only), PC A06/MF A01		DE89903315/JAW	MF-000
88-83	14:40795	NTIS (US Sales Only), PC A06/MF A01		DE89903293/JAW	MF-000
89-11	14:40475	NTIS (US Sales Only), PC A05/MF A01		DE89903296/JAW	MF-000
89-13	14:40796	NTIS (US Sales Only), PC A06/MF A01		DE89903295/JAW	MF-000
IWGFPT–					
31	14:40202	NTIS (US Sales Only), PC A05/MF A01 - OSTI		DE89014735/JAW	MF-000
IYF-R–					
3-268	14:40609	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632506/JAW	MF-000
3-291	14:40610	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632507/JAW	MF-000
JAERI-M–					
88-205	14:41368	NTIS (US Sales Only), PC A04/MF A01		DE89790756/JAW	MF-000
89-046	14:41227	NTIS (US Sales Only), PC A04/MF A01 - OSTI		DE89014339/JAW	MF-000
JET-R–					
88-19	14:41346	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632021/JAW	MF-000
88-20	14:41347	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632016/JAW	MF-000

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JHU/APL-TG–					
1373	14:40544	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015140/JAW	MF-506
JINR–					
13-88-457	14:40797	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633710/JAW	MF-000
JINR-E–					
1-88-244	14:41230	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632416/JAW	MF-000
1-88-669	14:41146	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618958/JAW	MF-000
2-88-493	14:41181	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632174/JAW	MF-000
2-88-518	14:41182	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89632175/JAW	MF-000
2-88-541	14:41190	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631764/JAW	MF-000
4-88-471	14:41183	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89632176/JAW	MF-000
5-88-565	14:41327	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631628/JAW	MF-000
JINR-R–					
11-88-491	14:41393	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633849/JAW	MF-000
2-88-507	14:41184	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632177/JAW	MF-000
2-88-515	14:41328	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631629/JAW	MF-000
2-88-569	14:41329	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631630/JAW	MF-000
4-88-574	14:41330	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631636/JAW	MF-000
9-88-366	14:40766	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633434/JAW	MF-000
9-88-423	14:40767	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633435/JAW	MF-000
Juel-Spez–					
444	14:40798	NTIS (US Sales Only), PC A06/MF A01		DE89794684/JAW	MF-000
449	14:40872	NTIS (US Sales Only), PC A04/MF A01		DE89794685/JAW	MF-000
490	14:39806	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89794893/JAW	MF-000
KFK–					
4493	14:40280	NTIS (US Sales Only), PC A04/MF A01		DE89795006/JAW	MF-000
4549	14:39927	NTIS (US Sales Only), PC A05/MF A01		DE89795007/JAW	MF-000
4552	14:40476	NTIS (US Sales Only), PC A03/MF A01		DE89794943/JAW	MF-000
KFKI–					
1989-01/D	14:41348	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632019/JAW	MF-000
1989-02/G	14:40281	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633850/JAW	MF-000
1989-05/A	14:41201	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631671/JAW	MF-000
1989-06/A	14:41202	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631672/JAW	MF-000
1989-07/A	14:41203	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631673/JAW	MF-000
1989-08/B	14:41204	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631674/JAW	MF-000
1989-10/G	14:40206	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89633559/JAW	MF-000
1989-11/G	14:40207	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633560/JAW	MF-000
1989-12/G	14:40208	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633561/JAW	MF-000
1989-13/G	14:40209	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633562/JAW	MF-000
1989-14/A	14:41205	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631675/JAW	MF-000
1989-15/A	14:41206	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631676/JAW	MF-000
1989-17/D	14:40799	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633740/JAW	MF-000
KIYI–					
88-13	14:41236	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632428/JAW	MF-000
KTH-KTR–					
89-12	14:40138	*See* STEV-FGT–89-3			
LA–					
11452-MS	14:39974	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015327/JAW	MF-814
11487-T	14:40887	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015751/JAW	MF-721
11540	14:40477	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014362/JAW	PC-704
11620-PR	14:40675	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014361/JAW	PC-401
11624-MS	14:41008	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015738/JAW	MF-408
11635-M	14:40800	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015793/JAW	MF-700
210/89	14:40960	*See* OEFZS–4489			
LA-UR–					
89-1345	14:40845	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011172/JAW	MF-741
89-1438	14:40801	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012599/JAW	MF-700
89-1466	14:41191	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012598/JAW	MF-414
89-1559	14:40079	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013209/JAW	MF-700
89-1636	14:40693	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012612/JAW	MF-706
89-1886	14:40830	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014240/JAW	MF-706
89-2125	14:41394	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014224/JAW	MF-705
89-2140	14:40749	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014293/JAW	MF-706
89-2214	14:40080	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015273/JAW	MF-700
89-2241	14:39928	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015243/JAW	MF-700
89-2242	14:40081	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015240/JAW	MF-700
89-2259	14:40663	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015272/JAW	MF-732
89-2301	14:40694	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015271/JAW	MF-700
89-2381	14:41031	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015262/JAW	MF-706
89-2425	14:40335	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015253/JAW	MF-400

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-2486	14:40478	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015345/JAW	MF-700
89-2520	14:41314	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015292/JAW	MF-410
89-374	14:40662	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007749/JAW	MF-741
89-431	14:40835	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007742/JAW	MF-741
89-432	14:40836	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007741/JAW	MF-741
89-433	14:40837	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007763/JAW	MF-741
89-434	14:40838	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007762/JAW	MF-741
89-459	14:40839	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007756/JAW	MF-741
89-520	14:40840	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007991/JAW	MF-701
89-536	14:40841	NTIS, PC A02/MF A01 - OSTI		DE89007987/JAW	MF-741
89-601	14:40842	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008000/JAW	MF-741
89-689	14:40843	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008016/JAW	MF-741
89-872	14:40844	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009387/JAW	MF-741
LAL–					
8816	14:41147	NTIS (US Sales Only), PC A10/MF A01		DE89903162/JAW	MF-000
LBL–					
26288	14:41155	*See* BNL–42650			
26589	14:41032	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015448/JAW	MF-412
26857	14:41186	*See* RAL–89-020			
27103	14:40695	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015224/JAW	MF-406
27183	14:40683	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014888/JAW	MF-406
27218	14:40493	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015314/JAW	MF-404
27265	14:40664	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015229/JAW	MF-404
27288	14:41185	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014887/JAW	MF-414
27293	14:41033	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015348/JAW	MF-412
27314	14:40676	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015225/JAW	MF-408
27321	14:41315	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015236/JAW	MF-411;MN-404
27322	14:41249	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015227/JAW	MF-413
27328	14:40802	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015344/JAW	MF-414
27411	14:41148	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015234/JAW	MF-413;MN-414
LPCC-T–					
88-01	14:41231	NTIS (US Sales Only), PC A06/MF A01		DE89903301/JAW	MF-000
LPNHEP–					
88-10	14:41149	NTIS (US Sales Only), PC A06/MF A01		DE89903175/JAW	MF-000
89-01	14:41207	NTIS (US Sales Only), PC A02/MF A01		DE89903227/JAW	MF-000
LUSG-WP–					
501	14:40348	The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ			ND-000
LUTEDX-TEEM–					
1032-1-162-1985	14:40396	NTIS (US Sales Only), PC A08/MF A01		DE89902410/JAW	MF-000
1036-1-48-1988	14:40710	NTIS (US Sales Only), PC A04/MF A01		DE89902411/JAW	MF-000
LUTMDN-TMVK–					
5175-1-54-1989	14:40178	NTIS (US Sales Only), PC A04		DE89902443/JAW	MF-000
LYCEN–					
88-02	14:41208	NTIS (US Sales Only), PC A02/MF A01		DE89903230/JAW	MF-000
88-29	14:41331	NTIS (US Sales Only), PC A02/MF A01		DE89903226/JAW	MF-000
8830	14:40479	NTIS (US Sales Only), PC A03/MF A01		DE89903224/JAW	MF-000
LYCEN-T–					
8824	14:40665	NTIS (US Sales Only), PC A09/MF A01		DE89903231/JAW	MF-000
Lund-MPh–					
88/4	14:41250	NTIS (US Sales Only), PC A04/MF A01		DE89795245/JAW	MF-000
MEFOS-BTF–					
87044	14:40423	*See* STU–85-4925			
MICROLOG–					
89-00753	14:40912	*See* AL-ESRF–090			
89-01551	14:40730	*See* MU/CCORE–1988			
MINTEK-M–					
356	14:41023	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE89015031/JAW	MF-000
MU/CCORE–					
1988	14:40730	Centre for Cold Ocean Resources Engineering, C-CORE, Memorial University of Nfld., St. John's, NF, Canada A1B 3X5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
NAL–					
TM-590	14:40711	NTIS (US Sales Only), PC A03/MF A01 - Available from National Aerospace Laboratory, 7-44-1, Jindaiji-higashi, Chofu, Tokyo, Japan		DE89772356/JAW	MF-000
TR-969	14:40432	NTIS (US Sales Only), PC A03/MF A01 - Available from National Aerospace Laboratory. 7-44-1, Jindaiji-higashimachi, Chofu-shi, Tokyo		DE89772311/JAW	MF-000
TR-970T	14:40712	NTIS (US Sales Only), PC A03/MF A01 - Available from National Aerospace Laboratory. 7-44-1, Jindaiji-higashimachi, Chofu-shi, Tokyo		DE89772310/JAW	MF-000
NASA-TM–					
102085	14:40144	*See* DOE/NASA/33408–3			
NEANDC(J)–					
134-L	14:40231	*See* INDC(JPN)–121-L			
135/U	14:41227	*See* JAERI-M–89-046			
NEDOJ–					
8809	14:41379	NTIS (US Sales Only), PC A23/MF A01 - Available from New Energy Development and Industrial Technology Organization, Tokyo, Japan		DE89760510/JAW	MF-000
8810	14:39807	NTIS (US Sales Only), PC A15/MF A01 - Available from New Energy Development and Industrial Technology Organization, Tokyo, (Japan)		DE89760508/JAW	MF-000
8811	14:40124	NTIS (US Sales Only), PC A23/MF A01 - Available from New Energy and Industrial Technology Development Organization, Tokyo, (Japan)		DE89760509/JAW	MF-000
NEI-DK–					
177	14:39859	NTIS (US Sales Only), PC A05/MF A01		DE89902273/JAW	MF-000
178	14:40326	NTIS (US Sales Only), PC A08/MF A01		DE89902277/JAW	MF-000
NIIAR–					
1(712)	14:40210	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633563/JAW	MF-000
2(733)	14:40263	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633618/JAW	MF-000
NIKHEF-H–					
89-4	14:41209	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630142/JAW	MF-000
NPL-RS(EXT)–					
93	14:40803	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633741/JAW	MF-000
NRCN(LS)–					
023	14:40959	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633043/JAW	MF-000
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576	14:40264	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633491/JAW	MF-000
NRPB-R–					
191	14:41264	H.M. Stationery Office, London, price Pound 5.00			ND-000
218	14:39975	H.M. Stationery Office, London, price Pound 9.00			ND-000
NSS/R–					
116	14:40677	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632606/JAW	MF-000
NUREG–					
0540-Vol.2-No.5	14:40224	NTIS, PC A17/MF A01 - GPO - OSTI		TI89015791/JAW	MF-000
0750-Vol.29-Index-1	14:40225	NTIS, PC A03/MF A01 - GPO - OSTI		TI89015765/JAW	MF-000
0750-Vol.29-No.5	14:40226	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015861/JAW	MF-000
0940-Vol.8-No.1	14:40227	NTIS, PC A19/MF A01 - GPO - OSTI		TI89014620/JAW	MF-000
1218	14:40251	NTIS, PC A03/MF A01 - GPO - OSTI		TI89015829/JAW	MF-000
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4674-Vol.7	14:40304	NTIS, PC A07/MF A01 - GPO - OSTI		TI89015721/JAW	MF-000
4674-Vol.8	14:40305	NTIS, PC A99/MF A01 - GPO - OSTI		TI89015711/JAW	MF-000
5152	14:40228	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015019/JAW	MF-000
5383	14:40237	NTIS, PC A07/MF A01 - GPO - OSTI		TI89015734/JAW	MF-000
5387	14:40920	NTIS, PC A14/MF A01 - GPO - OSTI		TI89015712/JAW	MF-000
5400	14:39977	NTIS, PC A06/MF A01 - GPO - OSTI		TI89015123/JAW	MF-000
5401	14:40545	NTIS, PC A11/MF A01 - GPO - OSTI		TI89014855/JAW	MF-000
NUREG/IA–					
0015	14:40306	NTIS, PC A03/MF A01 - GPO - OSTI		TI89015947/JAW	MF-000
0016	14:40307	NTIS, PC A05/MF A01 - GPO - OSTI		TI89015948/JAW	MF-000
0017	14:40308	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015933/JAW	MF-000
0020	14:40309	NTIS, PC A18/MF A01 - GPO - OSTI		TI89015937/JAW	MF-000
OEFZS–					
4489	14:40960	NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS		DE89631204/JAW	MF-000
ORNL/CON–					
263/V1	14:40397	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014348/JAW	MF-920
263/V2	14:40398	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014349/JAW	MF-920
ORNL/FTR–					
3311	14:40125	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015733/JAW	MF-408

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
3312	14:40933	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015090/JAW	MF-600
3318	14:40494	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015732/JAW	MF-404
3319	14:40495	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015831/JAW	MF-404
3321	14:41251	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015089/JAW	MF-413
3323	14:41220	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015832/JAW	MF-413
3324	14:41316	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015825/JAW	MF-410
3327	14:40739	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015824/JAW	MF-414
ORNL/M–					
535	14:40873	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015810/JAW	MF-600
ORNL/NOAC–					
232-Vol.7	14:40304	*See* NUREG/CR–4674-Vol.7			
232-Vol.8	14:40305	*See* NUREG/CR–4674-Vol.8			
ORNL/RASA–					
88/66	14:40904	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015072/JAW	MF-511
88/67	14:40905	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015823/JAW	MF-511
88/68	14:40906	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015080/JAW	MF-511
88/72	14:40907	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015081/JAW	MF-511
ORNL/TM–					
10700	14:39978	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014368/JAW	MF-512
11089	14:41395	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014347/JAW	MF-405
11224	14:40942	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014367/JAW	MF-407
11229	14:40433	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014345/JAW	MF-334
PATENTS-USA–					
4,820,925	14:40875	Patent and Trademark Office, Box 9, Washington, DC 20232			
PCCF-T–					
8801	14:41223	NTIS (US Sales Only), PC A07/MF A01		DE89903169/JAW	MF-000
8804	14:41224	NTIS (US Sales Only), PC A06/MF A01		DE89903160/JAW	MF-000
PFC/RR–					
89-3	14:41363	*See* DOE/ID/01570–4			
89-4	14:41364	*See* DOE/ID/01570–5			
89-6	14:41360	*See* DOE/ET/51013–267			
89-7	14:41361	*See* DOE/ET/51013–268			
89-8	14:41362	*See* DOE/ET/51013–270			
PNL–					
6800-Pt.1	14:40943	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013991/JAW	MF-408
6843	14:40204	*See* EPRI-NP–6032			
6886	14:39979	NTIS, PC A24/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014359/JAW	MF-502;MN-507
6905	14:40856	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014369/JAW	MF-500
PNL-SA–					
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16162	14:40238	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015836/JAW	MF-502
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16233	14:40696	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015328/JAW	MF-721
16290	14:41380	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014920/JAW	MF-500
16553	14:39980	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014928/JAW	MF-512
16632	14:40934	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014926/JAW	MF-401
16682	14:41396	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014919/JAW	MF-505
16731	14:40915	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014924/JAW	MF-502
16829	14:39981	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015839/JAW	MF-510
16848	14:41037	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014916/JAW	MF-412
16858	14:40969	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014929/JAW	MF-507
16864	14:40496	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015514/JAW	MF-404
16946	14:40720	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015838/JAW	MF-504
17093	14:40863	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015840/JAW	MF-502
17126	14:41009	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015837/JAW	MF-000
17174	14:40082	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015835/JAW	MF-504
PPPL–					
2603	14:41349	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014415/JAW	PC-426
2627	14:41371	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014416/JAW	PC-420;STD-424;STD-427
2632	14:41350	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014414/JAW	PC-427
2633	14:41372	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014335/JAW	PC-420;STD-421;STD-423;STD-426

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2635	14:41351	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014336/JAW	PC-420;STD-427
2636	14:41352	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014342/JAW	PC-426
2637	14:41353	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014343/JAW	PC-420
PTB-Dos–					
17	14:40818	NTIS (US Sales Only), PC A03/MF A01		DE89794900/JAW	MF-000
PTB-SE–					
21	14:40970	NTIS (US Sales Only), PC A03/MF A01		DE89794680/JAW	MF-000
PUPT–					
89-1133	14:41028	*See* FERMILAB-PUB–89/140-A			
PtUB–					
21	14:39916	Copy held by UB/TIB Hannover.			MF-000
QR–					
7020-1	14:39849	*See* DOE/PC/88943–T1			
RAL–					
89-008	14:41210	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89631677/JAW	MF-000
89-020	14:41186	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632178/JAW	MF-000
89-022	14:41034	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632037/JAW	MF-000
89-024	14:41258	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632247/JAW	MF-000
89-027	14:41187	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632179/JAW	MF-000
RISO-M–					
2785	14:40881	NTIS (US Sales Only), PC A03/MF A01;1 - Risoe Library, DK-4000 Roskilde		DE89902325/JAW	MF-000
RISO-R–					
565	14:41384	NTIS (US Sales Only), PC A03/MF A01;1 - Risoe Libary, DK-4000 Roskilde		DE89902327/JAW	MF-000
RNIIRP–					
88-3	14:40097	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633351/JAW	MF-000
RTS-R–					
003	14:40313	H.M. Stationery Office, London, price Pound 10.00			ND-000
SAIC–					
88/3015	14:40228	*See* NUREG/CR–5152			
SAND–					
87-2699	14:39986	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013997/JAW	MF-814
87-7120	14:40697	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013992/JAW	MF-406
87-7150	14:40698	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013874/JAW	MF-705
88-0495	14:40831	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009638/JAW	MF-700
88-1519C	14:40547	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008678/JAW	MF-741
88-2190C	14:40211	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009072/JAW	MF-000
88-2237C	14:40203	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008713/JAW	MF-000
88-2292C	14:40846	NTIS, PC A02/MF A01 - OSTI		DE89006770/JAW	MF-742
88-2380C	14:40410	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008197/JAW	MF-742
88-2427C	14:41397	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015739/JAW	MF-405
88-2596	14:40411	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014329/JAW	MF-706
88-3279C	14:40699	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006232/JAW	MF-706
88-3362	14:40721	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014350/JAW	PC-722
88-3422	14:40851	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014338/JAW	MF-706
88-3442C	14:40724	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89005924/JAW	MF-706
89-0053C	14:40700	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006509/JAW	MF-705
89-0087C	14:41018	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015841/JAW	MF-703
89-0180C	14:40847	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006443/JAW	MF-741
89-0196C	14:40848	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006504/JAW	MF-741
89-0525C	14:40500	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014548/JAW	MF-704
89-0534C	14:40548	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015844/JAW	MF-704
89-0540C	14:40701	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014478/JAW	MF-706
89-0643C	14:41332	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015850/JAW	MF-705
89-0660	14:40725	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014328/JAW	MF-706
89-0716	14:40769	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014337/JAW	MF-414
89-0778	14:40722	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014352/JAW	MF-705
89-0857C	14:40549	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015889/JAW	MF-704
89-0867C	14:41317	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014549/JAW	MF-704
89-0886C	14:41051	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013936/JAW	MF-712
89-0899	14:40145	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013971/JAW	MF-236
89-1060C	14:40550	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015490/JAW	MF-701
89-1061C	14:40551	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014941/JAW	MF-704;MN-706
89-1273C	14:40667	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015795/JAW	MF-700
89-1301C	14:40713	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012662/JAW	MF-706
89-1308C	14:41398	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012677/JAW	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-1369	14:40852	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014351/JAW	MF-706
89-1409C	14:40083	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013258/JAW	MF-700
89-1504	14:39884	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013993/JAW	MF-132
89-1543	14:40132	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013881/JAW	MF-272;MN-274;MN-275
89-1715	14:41399	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014353/JAW	MF-605
89-1756C	14:40552	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014135/JAW	MF-704
89-1828C	14:40553	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015851/JAW	MF-706
89-2504C	14:40849	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014900/JAW	MF-741
89-7100	14:41409	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013998/JAW	MF-405
SCIPP–					
88/38	14:41155	*See* BNL–42650			
89/14	14:41157	*See* BNL–42854			
SERI/STR–					
211-3530	14:40133	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009441/JAW	MF-271
217-3405	14:40163	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000900/JAW	MF-261
253-3485	14:40146	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000899/JAW	MF-262
SFTI–					
88-4	14:41052	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631806/JAW	MF-000
SIB-SB–					
15	14:40330	NTIS (US Sales Only), PC A10/MF A01		DE89902473/JAW	MF-000
SIB-TN–					
2	14:40399	NTIS (US Sales Only), PC A04/MF A01		DE89902401/JAW	MF-000
5	14:40400	NTIS (US Sales Only), PC A04/MF A01		DE89902404/JAW	MF-000
7	14:40401	NTIS (US Sales Only), PC A05/MF A01		DE89902399/JAW	MF-000
8	14:40402	NTIS (US Sales Only), PC A04/MF A01		DE89902442/JAW	MF-000
10	14:40403	NTIS (US Sales Only), PC A04/MF A01		DE89902400/JAW	MF-000
SJF-Orientering–					
56	14:40421	NTIS (US Sales Only), PC A03/MF A01		DE89902324/JAW	MF-000
SLAC-PUB–					
4795	14:40819	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013878/JAW	PC-414
4858	14:40770	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014394/JAW	PC-414
4875	14:40820	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013889/JAW	PC-414
4886	14:40750	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013890/JAW	PC-414
4951	14:41333	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011287/JAW	PC-414
4990	14:41150	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013892/JAW	PC-414
4996	14:40740	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013895/JAW	PC-414
5010	14:40741	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013989/JAW	PC-414
5011	14:40751	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013988/JAW	PC-414
5013	14:41151	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013984/JAW	PC-414
5020	14:40752	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014396/JAW	PC-414
5029	14:41188	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013983/JAW	PC-414
SNV–					
3453	14:40877	NTIS (US Sales Only), PC A13/MF A01		DE88755865/JAW	MF-000
3491	14:40422	NTIS (US Sales Only), PC A04/MF A01		DE89902413/JAW	MF-000
3493	14:40429	NTIS (US Sales Only), PC A06/MF A01		DE89902412/JAW	MF-000
3521	14:40111	NTIS (US Sales Only), PC A03/MF A01		DE89902415/JAW	MF-000
3532	14:40259	NTIS (US Sales Only), PC A03/MF A01		DE89795244/JAW	MF-000
3549	14:40910	NTIS (US Sales Only), PC A03/MF A01		DE89902398/JAW	MF-000
3568	14:39862	Statens Naturvaardsverk, Solna (Sweden). Tekniska Avdelningen			ND-000
STEV–					
1988-R11	14:39881	NTIS (US Sales Only), PC A05/MF A01		DE89902385/JAW	MF-000
1988-R13	14:40430	NTIS (US Sales Only), PC A05/MF A01		DE89902384/JAW	MF-000
1988-R14	14:40336	NTIS (US Sales Only), PC A04/MF A01		DE89902438/JAW	MF-000
STEV-EO–					
89-9	14:40134	NTIS (US Sales Only), PC A04/MF A01		DE89902416/JAW	MF-000
89-10	14:40135	NTIS (US Sales Only), PC A02/MF A01		DE89902417/JAW	MF-000
89-11	14:40136	NTIS (US Sales Only), PC A03/MF A01		DE89902460/JAW	MF-000
STEV-FBT–					
89-22	14:40729	NTIS (US Sales Only), PC A03/MF A01		DE89902420/JAW	MF-000
89-23	14:40112	NTIS (US Sales Only), PC A03/MF A01		DE89902462/JAW	MF-000
STEV-FGT–					
89-2	14:40137	NTIS (US Sales Only), PC A03/MF A01		DE89902418/JAW	MF-000
89-3	14:40138	NTIS (US Sales Only), PC A12/MF A01		DE89902419/JAW	MF-000
89-4	14:40139	NTIS (US Sales Only), PC A04/MF A01		DE89902461/JAW	MF-000
STEV-TORV–					
89-5	14:39790	NTIS (US Sales Only), PC A03/MF A01		DE89902421/JAW	MF-000

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STEV-VIND–					
89-1	14:40164	NTIS (US Sales Only), PC A03/MF A01		DE89902463/JAW	MF-000
89-7	14:40858	NTIS (US Sales Only), PC A03/MF A01		DE89902468/JAW	MF-000
89-9	14:40331	NTIS (US Sales Only), PC A08/MF A01		DE89902469/JAW	MF-000
89-10	14:40165	NTIS (US Sales Only), PC A03/MF A01		DE89902464/JAW	MF-000
89-11	14:40723	NTIS (US Sales Only), PC A03		DE89902465/JAW	MF-000
89-12	14:40166	NTIS (US Sales Only), PC A03/MF A01		DE89902466/JAW	MF-000
STU–					
85-4187	14:40152	NTIS (US Sales Only), PC A06		DE89902433/JAW	MF-000
85-4925	14:40423	NTIS (US Sales Only), PC A04/MF A01		DE89902434/JAW	MF-000
87-1687	14:40424	NTIS (US Sales Only), PC A05/MF A01		DE89902435/JAW	MF-000
STUB–					
22	14:40101	NTIS (US Sales Only), PC A03/MF A01		DE89902322/JAW	MF-000
24	14:40102	NTIS (US Sales Only), PC A03/MF A01		DE89902323/JAW	MF-000
35	14:40103	NTIS (US Sales Only), PC A03/MF A01		DE89902321/JAW	MF-000
STUDSVIK-EP–					
88-39	14:40112	*See* STEV-FBT–89-23			
89-2	14:40137	*See* STEV-FGT–89-2			
STUDSVIK-NP–					
87/10	14:40308	*See* NUREG/IA–0017			
STUK-B-YTO–					
51	14:40212	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633564/JAW	MF-000
52	14:40213	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633565/JAW	MF-000
58	14:40214	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633566/JAW	MF-000
SV-UB–					
1987-55	14:40116	NTIS (US Sales Only), PC A04/MF A01		DE89902402/JAW	MF-000
SV-UE–					
1988-47	14:40167	NTIS (US Sales Only), PC A09/MF A01		DE89902437/JAW	MF-000
SV-UG–					
1988-42	14:39902	NTIS (US Sales Only), PC A03/MF A01		DE89902436/JAW	MF-000
1989-1	14:41381	NTIS (US Sales Only), PC A05/MF A01		DE89902439/JAW	MF-000
1989-2	14:39903	NTIS (US Sales Only), PC A06/MF A01		DE89902440/JAW	MF-000
SV-UL–					
89-3	14:40404	NTIS (US Sales Only), PC A03/MF A01		DE89902441/JAW	MF-000
Stralenbescherming–					
39-B	14:40971	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89631215/JAW	MF-000
TKK-DISS–					
695	14:40260	*See* YJT–89-01			
TPR-NS–					
30-No.2	14:40314	GPO; $8.50			MF-607;STD-607
TR-EL–					
82-4	14:40911	U.S. Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458 - OSTI		TI89015917/JAW	MF-000
TRITA-BYTE-AR–					
1987-2	14:40405	NTIS (US Sales Only), PC A09/MF A01		DE89902403/JAW	MF-000
TTC–					
0892	14:40721	*See* SAND–88-3362			
UBA-FB–					
86-069	14:41010	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89794682/JAW	MF-000
UCB-PTH–					
89-3	14:41186	*See* RAL–89-020			
89/13	14:41185	*See* LBL–27288			
UCD–					
88-30	14:41155	*See* BNL–42650			
UCID–					
21397	14:40064	NTIS, PC A13/MF A01 - OSTI		DE89015710/JAW	MF-721
21399	14:41152	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013980/JAW	MF-000
21574-Rev.1	14:41354	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014370/JAW	MF-420
21595	14:41038	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012812/JAW	MF-000
21635	14:41053	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013979/JAW	MF-705
21662	14:41153	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013978/JAW	MF-000
21689	14:41400	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014324/JAW	MF-705
21690-Com.	14:40864	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013981/JAW	MF-402
21694	14:41221	NTIS, PC A03/MF A01 - OSTI		DE89013972/JAW	MF-705
21713	14:40853	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014371/JAW	MF-700
21720	14:40855	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013976/JAW	MF-742
21724	14:40554	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013974/JAW	MF-704

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21725	14:41373	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014326/JAW	MF-706
21788	14:40854	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013973/JAW	MF-700
UCRL–					
100236	14:41334	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014267/JAW	MF-000
100317	14:40771	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015771/JAW	MF-000
100320	14:40772	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015770/JAW	MF-000
100321	14:40753	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015769/JAW	MF-000
100322	14:40743	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015772/JAW	MF-000
100355	14:40726	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015774/JAW	MF-706
100358	14:40702	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015077/JAW	MF-712;MN-706
100363	14:40754	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015049/JAW	MF-706
100644	14:40850	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008826/JAW	MF-741
100709-Rev.1	14:41054	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015778/JAW	MF-700
100996	14:40434	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015724/JAW	MF-700
101082	14:40501	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015722/JAW	MF-701
101085	14:41401	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013790/JAW	MF-705
101165	14:39808	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016640/JAW	MF-109
101200	14:41011	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014178/JAW	MF-000
101209	14:41402	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015116/JAW	MF-405
101218	14:40935	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015115/JAW	MF-708
101263	14:40832	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014052/JAW	MF-706
101286	14:41376	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015777/JAW	MF-712
101309	14:41318	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015705/JAW	MF-411
101401	14:40337	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016639/JAW	MF-121
101502	14:40936	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015330/JAW	MF-408
101505	14:41012	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015331/JAW	MF-408
101566	14:39887	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015117/JAW	MF-405
21187	14:40065	NTIS, PC A05/MF A01 - OSTI		DE89015780/JAW	MF-702;MN-703
21194	14:40555	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015726/JAW	MF-706
21204	14:41077	NTIS, PC A05/MF A01 - OSTI		DE89015088/JAW	MF-705
21207	14:41374	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015728/JAW	MF-706
53809-88	14:41035	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014363/JAW	PC-700
99316-Rev.2	14:41375	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014042/JAW	MF-706
99579	14:40742	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016658/JAW	MF-000
99969-Rev.1	14:40874	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016634/JAW	MF-700
UFPB-DF–					
01/89	14:41252	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632275/JAW	MF-000
UUIP–					
1181	14:40098	NTIS (US Sales Only), PC A03/MF A01		DE89902414/JAW	MF-000
WAPD-TM–					
1628	14:41259	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014418/JAW	PC-413
WHC-EP–					
0250-Vol.1	14:39987	NTIS, PC A20/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015037/JAW	MF-721
WHC-SA–					
0174	14:40916	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014947/JAW	MF-702;MN-706
WINCO–					
1061	14:41036	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014332/JAW	PC-412
YJT–					
89-01	14:40260	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89632949/JAW	MF-000
89-04	14:40922	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632953/JAW	MF-000

Order Number Correlation

The correlation list is provided for those organizations that file documents by report number but may receive requests by order number. For more information about a document, refer to the Report Number Index.

Order No.	*Report No.*
DE88755865	SNV–3453
DE89000756	DOE/MC/21136–21
DE89000867	DOE/CH/10093–52
DE89000899	SERI/STR–253-3485
DE89000900	SERI/STR–217-3405
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Portland, OR 97207
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